STRAY LEAVES

FROM

THE BOOK OF NATURE.

BY

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"I grieve not that ripe knowledge takes away
The charm that Nature to my childhood wore,
For with the insight cometh day by day,
A greater bliss than wonder was before.
To win the secret of a weed's plain heart,
Reveals the clue to spiritual things.
The soul that looks within for truth may guess
The presence of some unknown heavenliness."

J. Russell Lowell.

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FROM THE

BOOK OF NATURE.

I.

Only a Pebble.

"All Nature widens upward. Evermore
The simpler essence lower lies:
More complex is, more perfect, owning more,
Discourses more widely wise."—TENNYSON.

AWAY out in Mesopotamia, the traveller sees vast plains unroll themselves before his wondering eye, and scattered over them many a grassy knoll with its flock of goats and camels. No one suspected that under those hills lay buried the ancient glory of Nineveh, "an exceeding great city of three days' journey, wherein are more than six score thousand persons." Like the faint echo of distant thunder, a few half-forgotten names and vague, dream-like legends, were all that had come down

to us from the vast empire, whose merchants were many, "even as the stars in heaven." But a man came from a far off island, he gathered the stones that lay scattered about, and the silence, that had brooded over them for countless ages, was broken by his magic touch. Here he found on a brick strange and yet familiar signs; there he dug, out of the rubbish of thousands of years, costly slabs of alabaster, and on them were carved gigantic, awe-inspiring figures. The Bible in his hand he read, and name after name resumed life and meaning, until at last the whole of its wondrous splendor was unfolded before him.

And thus there lies many a stone in our path that might teach us lessons of grave import—for when the traditions of men are silent, stones become eloquent. But we thrust them aside and we say with contempt: It is only a pebble! We call it dead, lifeless nature. Oh, if it were a noble animal, a beauteous plant! or even a rusty coin, a worm-eaten parchment, upon which some ancient dreamer wrote his long-forgotten fancies about heaven and earth—how we would tax our ingenuity, how we would search through the wide field of human knowledge, and bring the wisdom of ages to bear upon the great secret! For are not coins and parchments the work of man? He deigns not to read the bright letters with which Earth herself has written her history on the simple sides of a pebble.

Only a pebble! Oh man, that stone which you thrust so contemptuously out of your way, is older than all else on this earth! When the waters under heaven were

gathered together unto one place, that pebble was there. Who can tell us the story of those first days, when the earth was in sore travail, when her heaving bosom belched forth torrents of fire, vast avalanches of hissing, seething water, and volumes of deadly vapors? When glowing, blazing streams of lava threw a bloody red glare on the silent, lifeless earth, and amidst a trembling and thundering that shook the firmament, a thousand volcanoes at once lifted up their fiery heads; when out of the foaming waters there rose suddenly the rocky foundations of firm land and greeted the light that God had created?

That pebble was Life's first offspring on earth. The Spirit of God moved on the waters, and life was breathed into the very gases that were hid in the heart of the vapory globe. They parted in love, they parted in hate; they fled and they met. Atom joined atom; loving sisters kissed each other, and this love, the great child of that Spirit on earth, brought forth its first fruit, the pebble! Other stones also arose; out of the dark chaos new brothers were seen to appear, and countless friends stood by the side of the first comer. Warmth spread through their limbs, electric currents shaped and fashioned them into ever new forms, and they were joined into families and races each in his kind.

And now the wild struggle subsided. The fierce spirits of fire were banished far down to the dark caverns of the earth; but in angry passion they still rage and roar below, rise in powerless fury until the earth trembles and the heart of man is awed, or pour forth streams of burning lava through mighty volcanoes. Thus the flames bring us,

even now, messages from the vasty deep, and the lava shows us that what is firm and fast on the surface is still boiling and seething below. Ever yet the unruly spirits trouble the earth. Here they lift Sweden or Chili high out of the vast ocean, there they draw Greenland and Italy down towards their unknown home. Ever yet the stones live; they lift up and sink islands, they fashion new lakes and fill up large streams; they pour fiery cataracts from lofty mountains and bury whole cities under vast volumes of ashes. They are ever active, and change, day by day, the very soil on which we live.

Such were the pebble's earliest days: Is he not well-born? But philosophers tell us that he was born only to die; that life was almost instantly followed by death. To a certain point this is true. As the rock was the first life that came to light from the chaos of atoms, so it also died at the moment of birth. The life-giving electric spark was even but a spark, and, its mission fulfilled, it vanished. The life, that was given from without, that was not inborn, could not continue. Now and then, it is true, fire breaks out anew, as if unable to bear any longer the bonds of death; but what, after all, can it do but lift the coffin's top for a while? No fire on earth can wake and warm the dead giant within to new life. And yet, even here, where death seems to reign sole and supreme, there are still mysterious powers at work that human wisdom has but partly explained. Place finely-powdered sand on a glass plate and let the clear mass give out a high or low note, and, behold! the stone, lifeless, soulless stone, listens to the harmonious sound, dances and frolics, and

ranges itself in wondrous stars and circles. What strange power has the so-called Bononian stone to keep the rays of the sun or the light of earth-kindled fire captive, and to let them loose again, long after it has been hidden in utter darkness? What gives the blood-red Turmalin its electric power? But electric currents pass even now, unseen and unnoticed, through the heart of the earth, and, under their influence, crystals arise and assume most beautiful shapes. Their forms are most simple, it is true, but so varied in their very simplicity, that man's ingenuity and most fertile fancy has not yet invented a new one. Nothing but straight lines are seen there, cubes and pyra mids, rhomboids and prisms, but they all glitter and glare in strange brilliancy, when a ray of light illumines them for an instant in their dark, inaccessible homes.

And if the stone itself does not live, and labor, and change, friends come from all sides to gladden his silent house and to deck it with precious colors. In the very midst of the rocky world live the merrier metals, and form a thousand delicate veins, bright crystals, and tender foliage. Imprisoned in the cold, hard rock, dwell iron and lead, gold and silver, now in safe inaccessible caves, and now mysteriously mixed with its very substance, as if they were lost, frozen rays of heavenly light. There they hide, buried in eternal night, and fancy they have escaped all foes from beneath; but they dream not of the much more dangerous enemies who live above them and know their secret chambers, even if they cannot look down into the impenetrable darkness of the rocky world. The bold miner digs and drills, and fearlessly descends

into the very heart of the earth; there he breaks through wall and rampart, and forces the rich metal from its ancient home to toil an humble slave in the service of man.

And is there no romance in the poor pebble's life—the only life on earth that all science of men cannot trace to its first beginning? The pebble was born when God made heaven and earth. The same hills, the same mountains, have covered the land from the day that man looked with awe upon the "everlasting hills." Nations have passed away, and races have vanished from among us, but even the pyramids stand yet in ancient glory and defy the power of ages. The mighty empires of the Pharaohs and the Ptolemies have fallen before the enemy; the laws of the Medes and the Persians, that changed not, are forgotten; the hut of the Arab and the palace of the conqueror have alike crumbled into dust—but the unchanging rocks rise still high and unbroken from the midst of ruins.

And yet even mountains are not everlasting, and rocks not eternal. What would be their life without a change, and what their existence without a struggle? Even the poor pebble has thus a life of his own, rich in adventure, lofty in its character, and glorious in its end.

We see the pebble only as it lies sullen and silent near the bank of a brook, perhaps amidst high luxuriant tufts of grass that grow in his shade, and feed on his life's marrow. Around him, on the overhanging banks, stand bright-colored flowers and gaze, with maidens' vanity, upon their image in the crystal waters below them. All around him is life and motion. On the wings of the tempest the

clouds above him race up the heavens and down again. Thick pearly drops of cooling rain patter from on high, and rise soon after, in clear, invisible vapors, back to the sunny height from which they came. Untiring wings carry the birds of heaven to their distant homes. Restless brooks rush in eager haste from the snow-covered Alps to the sunny plains; broad streams pour majestically their huge floods into the great ocean, and hasten with its gigantic waves around our globe. The beasts of the field wander from land to land; nations and empires are ever seen moving with a strange, mysterious impulse, towards the setting sun—the very trees and grasses of the earth move slowly, in man's wake, from zone to zone.

The pebble alone lies still and lonely by the wayside, and shuts his eyes not to see the merry, wandering life around him. Still, he also had his time when he travelled far over land and sea. High upon a lofty mountain-peak was his first home, and there his life, full of strife and struggle, began in fierce war with the elements. For there is enmity between them and the poor pebble. Mild but treacherous rains stole through cleft and crevice into every pore of the rock, and oozed from vein to vein, filling the core of the giant with indescribably delicate and wondrously ramified little canals. Then came hard winters that froze the swelling veins, and sent sharp daggers of icicles into his very marrow; they blasted his limbs, and rent them with insidious force into fragments. Balmy springs melted again the thousand sharp wedges; but already the poor rock rejoices no longer in his solid, massive strength; water and air have drilled and bored

countless little holes and channels through the vast body; each year snow and ice press further and further; the very air, full of destructive power, gnaws at every corner and every edge, until the high-swollen torrent at last worries the weary rock out of his ancient resting-place, and bears him for a moment in wild triumph high on its roaring, rollicking waves. Or perhaps cold, dazzling glaciers, bright, majestic icebergs, lifted him on their broad shoulders, and carried him high over wide plains or the ocean's unmeasured width, until at last he fell, with a fearful crash, that the splinters flew and the waters foamed. Even now the heavy rocks of the polar circle are carried, by the hand of colossal icebergs, from the eternal snows of their home to the sweet climes of the equator. Even now the glaciers of Alps and Andes bear down huge blocks of ancient granite to low meadows and distant waters. The green waters of the Rhine carry many a child of the ice-covered Alps to the fertile plains of the Netherlands, whilst the brother that was born on the same high throne, is torn from his side to wander on the dark waves of the Danube to the inhospitable shores of the Black Sea.

For, a fierce, untiring leveller, the water wages incessant war against the aristocrats of the earth. It gnaws and tears and wearies the loftiest mountain top season after season, age after age, and is never content until it has brought him low, and dragged him in spiteful contumely to its own great home, the ocean. Each river has to be a faithful, restless servant in the work of destruction. The Nile has created its Delta, the Rhine has formed

all Holland; before the Ganges and the Mississippi grow vast islands of mud and sand far into the ocean. The Po and the Rhine, like greater rivers, have even raised their own bed, so that they now flow above the surrounding plain, and costly levees only can keep our own Father of Rivers within his natural bounds. From high mountains come the unmeasured stores of finely-ground stone that cover the bed of the ocean. Every tide and every current, that approaches the coast, brings on its broad shoulders immense masses of sand, and heaps them, layer upon layer, until the downs of some countries rise to a height of two hundred feet. It is as if the poor exiled stone longed to return to its early home. Raging and roaring, new tides and new waves rush against their own offspring, but the humble pebble, strong in union, and hardened by the very pressure of the waters, resists their fury, checks the huge power of the ocean, and protects proud man in his possessions!

Man hardly dreams of the fierce, incessant warfare that is waged against the loftiest mountain chains of our earth. It is true we see Alpine torrents press angrily through their narrow bed, half filled with ruins, we hear the thunder of mighty rocks that fall with the terrible avalanche, we know even mountain sides to slide and to bury whole towns under their colossal weight. The dweller in high Alpine regions sees, through spring and through summer, large stones suddenly fly off from the steep, smooth sides of the highest rocks, often with such loud explosions and so constantly, as to resemble the regular fire of a platoon. The mountain shepherd sees, year after year, his pastures

encroached upon by masses of falling, crumbling rock, and the amazed traveller is seized with deep awe and vague fear, when he crosses the vast wastes, covered with thousands of silent stones, with which the elements have written their Mene Mene in colossal letters on the mountain slopes. But we are all accustomed to look upon these events as the rare occurrences of a year or a season. The tooth of Time works slowly, and generations pass away, ere its marks are seen by human eyes. The hand of Him in whose hands lies the fate of the earth, loves not to send plutonic powers to shake the mountains from their ancient foundations, and has promised that there "shall not be any more a flood to destroy the earth." But Alps and Andes, Cordilleras and Himalaya will fall, and the eternal mountains be levelled to the ground.

Our rock, hurled by his enemy from his ancient throne, now lies in some deep, dark ravine, where night and dead silence alone reign supreme. A giant block still, it hangs threatening in boldly towering masses over the precipice, and, in its sullen, stolid wrath, stems for a while the wild raging flood. Wave after wave falls back from his strong, rocky breast; year after year the rushing waters leap yelling over his proud head, or steal grumbling and growling past the invincible foe. But the victory is here also not to the strong. Step by step they push him down into the valley; limb after limb they tear from his body and grind them into fine sand; by day and by night, in winter and summer, they throw their whole power against him, until at last he resists no longer and becomes "only a pebble."

But a sadder fate still awaits him. The roaring fury of a swollen torrent seizes him and carries him off in wild haste. After a fierce chase down the steep sides of a mountain, he finds himself of a sudden in a new world. He wonders and marvels. He lies in a smiling meadow, glowing in the golden light of the sun and decked with gorgeous flowers. But alas! he cannot live in a world of light and air. A thousand new foes, small, unseen, and unnoticed, but all the more powerful, surround him. Sweet, prattling rivulets play with the new guest, and too late he finds that there is poison in their smile and a dagger in each embrace. The very air, this mere dream that the eye does not see, and the hand does not feel, attacks him with fatal energy. It pierces into his veins; it slips into the tiniest cleft; it loosens the sinews of his structure, and gnaws, with insatiable eagerness, at the very core of his life. The fiercest of all his enemies, called oxygen, sows discord among the imprisoned gases that hold the beautiful structure of the stone together. Subtle and cunning, it lures, first one and then another, from its ancient alliance; treacherously it draws them to the surface, and decks the unresisting victim with brilliant colors which conceal the certain destruction that is going on beneath the bright surface. The lifeless mass, no longer strong in union, begins to crumble into its elements. New forces are called to aid: electric fluids consume his last force, and galvanic currents tear and rend what has withstood all other influences. Utterly helpless and friendless, the poor pebble thus lies but a little while amidst the grasses that feed upon his very

substance. See, already moist-footed mosses have scaled up his sides, and, true parasites as they are, cling firmly to his dying body. Whole families of minute algæ have snugly ensconced themselves in every wrinkle of his weather-beaten face, and diminutive water-pools fill every scar and every dimple. Soon they will have hid him forever under the green turf of his grave, and slowly, slowly, he will moulder away under his moist grave-clothes.

And if he does at last succumb, the mighty rock—is it not a glorious strife, this never-ceasing battle between soft, elastic water, and cold, rigid stone? How they charge and charge again, these subtle, tiny drops of rain; these airy, gentle flakes of snow; these graceful crystals of icy hail! The great giant cannot resist the diminutive dwarfs. Truly, the battle is not to the strong, for the victor is the weak, wee drop of water, and so helpless is the colossal mountain, that it succumbs to the passing shower and the soft, elastic wave. For, in fact, its very massiveness is its sure ruin. His foes are light, airy beings—he cannot seize them, he cannot strangle them in his gigantic arms. The tiny brook wears its little rill with untiring industry into the rocky sides of the mountain; the torrent tears its flanks, spring after spring, with ever new and ever growing fierceness; huge glaciers break its mighty ribs; the air crumbles the lofty summit to pieces, and the proud giant sees his sad fate foreshadowed in the ruins that slowly, but surely, gather at his feet. There he stands, stern and stately still, the hero of Nature's great tragedy; boldly facing certain death, and yet manfully, nobly struggling against inevitable Fate. For there is

something peculiarly tragic in the simple fact, that the rock succumbs to the powers of that same life which he first bore, first nourished. He gathered around his lofty head the waters of the air—and the clouds and thunder-storms which he nursed in his bosom and bore many a long day on his mighty shoulders, strike, like thankless children, their sharp fangs into his side. Mosses and algæ, that found a safe home in his thousand chinks and clefts, eat their way into his substance, and caused his rocky surface to decay. Dark forests grew on his ridges, and he fed them age after age with his life's blood—but what is his reward? They sport with the vapors of the far-off ocean; they call them and keep them in loving embrace, or pour them in fierce rain and destructive hail upon his decaying sides. The very grasses with which he loved to deck his sweet, fragrant meadows, dig with spade and auger into the crumbling stone, and consume layer after layer. And when all these, his graceless children, cannot conquer the mighty giant, man comes to their aid, and with cruel machinery, with brutal powder, he breaks his iron limbs, and cuts and carves at his granite foundation. As the giants and titans of ancient Greece fell, one by one, victims of a higher power, in whose service they had won a noble fame, so the very life that the rock created and nourished, feeds in turn upon him, and Fate decrees his death through the results of his own colossal strength.

But there is Life in Death. Not in man's inspired writings only, but in every lineament, in every movement of our great mother Earth all around us, all over this

globe, Death seems to stalk triumphant. The summer passes away, flowers fade and fruits decay; field and meadow are buried in deep slumber. Broad lands are swallowed up by the hungry ocean, and gigantic mountains sink to be seen no more. But Death has found his conqueror in Nature also. What perishes, rises again; what fades away, changes but form and shape. Sweet spring follows winter; new life blossoms out of the grave.

So with stones also. The poor pebble lies unnoticed by the water's edge; soft rains come and loosen the bands that held him together; refined, almost spiritualized, he rises with the gentle water-drops into the delicate roots of plants. With the grass he passes into the grazing cattle, and through vein and artery, until at last he becomes part and portion of the being into which God himself has breathed the breath of life! And when dust returns to dust, he also is restored once more to his first home, after having served his great purpose in the household of Nature—not to rest or to perish forever, but to begin again the eternal course through death and life.

But even whilst yet "only a pebble," he claims our attention as the very Proteus of stones, that meets us in a thousand ever new and ever changing forms, at all times of our life, from the cradle to the grave, until we ourselves return dust to dust.

Far below in the vast deep of primeval mountains he dreams of the gay, light life on the sunny surface of the earth, of strange forms of plants, and of still stranger, free motions of animals. A new, irresistible impulse

seizes him, and he grows up—who knows how?—into a wondrous crystal, decked with bright colors, the very flowers of the subterranean world of stones. In lonely, silent caverns they light up the eternal night with a fire given them long before man trod upon earth. Like petrified sparks of light, here in diminutive littleness, there in gigantic size, they lie scattered about. Mighty rivers roll tiny fragments to the distant ocean. In the crystal caves of St. Gothard, the clear, glorious rock-crystal grows in bright, polished pyramids of one to eight hundred pounds' weight! Now and then it blends with the gay colors of metals, and appears as beautiful topaz, binding, as it were, the very smoke of subterranean fire in graceful stone, or as precious amethyst, whose violet crystals Aristotle praised for their beauty, and because, worn on the breast, they protected the wearer against the evils of drunkenness. Long and slender, fit to be the sceptre of the earth's sovereign, the pebble-crystal shines and glitters in the mines of Hungary; in Java his brilliant splendor is humbly hid in loose sand, and in our own Northern States it adorns the common sand-stone with bright, beautiful points. And if you hold the gay stone-flower to the light—what sparkles in its transparent bosom? The crystal holds in loving embrace a kindred spirit: a pure drop of water rests clear and bright in its glassy prison, and dreams of the sister drops that flit without in eager haste and restless strife through the wide, wide world.

There is no form that the pebble does not assume, no company that he despises. He is constantly changing

shape and home, to join countless other stones, metals, and earths, and, with them, to give new life and new beauty to the unknown mineral world. Invisible, he gushes forth in the clear waters of hot springs, from the very heart of the earth. The burning geysers of Iceland are not too hot for him; the very craters of Kamschatka afford him a comfortable home, and, with strange pleasure, he forms a stony armor around the tender stalks of graceful grasses.

As if he had lost his way and strayed from his path, he is found in chalk-mountains, far from his kindred, and oddly shaped in the form of flints, holding in his bosom the power of calling forth the hidden fire of metals. Everywhere his works are seen. Here he builds heaven-aspiring Alps, with deep abysses and lovely valleys; their lofty heads are buried in eternal ice, on which the morning and evening sun kindles fires that proclaim the power of the Almighty far over land and sea; from their sides thunder death-bearing avalanches and furious torrents, whilst at their feet lie green meadows and still waters, where the weary love to rest. There he raises huge domes, crowned with frowning forests, or he sends up, as if in sport, strange, quaintly-shaped columns of sandstone, that tower like enchanted castles above the plain. The pebble is the true architect of mountains; it is he who built their gigantic pyramids and their mighty cupolas; if we descend to the first stones of the plutonic world, there is the pebble; if we rise up to volcanic creation, even there we meet the despised pebble. Again he spreads himself out in dreary vastness over the plains

of Asia and Africa; he creates those terrible deserts, where the tinkling of the camel's bell alone breaks the dead silence. There the soil burns, the air glows, hot vapors alone seem to live. But even here the pebble tries to create new shapes. He gives himself up to the wild sports of the winds; like a huge water-spout he rushes up and down the fearful waste, or he paints, with enchanted colors, wondrous images of cool gardens, blue hills, and refreshing fountains.

Even into the other kingdoms of Nature he finds his way. He wrestles with the powers of the earth and, after conquest, compels them to serve him as useful allies. Wheat and oats, rye and barley, all need a flinty soil; all grasses, that feed our domestic animals and man himself, drink with their roots in rain and spring water, large quantities of dissolved flint. It is an humble and despised thing, the worthless straw and the low stalk of grass; and yet it surpasses in beauty and boldness of structure the graceful palm and the storm-defying oak. Slily, slowly, the pebble's tiniest parts mingle with the soft waters of the earth, and ascend, through root and radicle, into the heart of joyous plants. Man has no lofty steeple, the world no proud pyramid, that can compare with the airy and yet solid structure of the humble blade of grass. Thanks to the little pebble, its hollow column rises high above moss and clod; its tower fills story after story with rich food for man; the rain cannot enter into the safe chambers; the wind can bend but not break the elastic pillar.

Thus the pebble unites with his enemy, water, to create

a new world, and to become itself, as it were, a life-endowed being. He ceases to be the rigid, unbending stone; with the tiny drop he enters into organic creation. He feeds now as they do upon the ethereal elements of air and fire, and aids in building up a new kingdom of organic beings. Surely, there are sermons in stones. Was there ever sermon preached that taught more clearly the transfiguration of even lifeless matter, and its resurrection in a higher world?

The pebble spends, however, not all of his creative power on the Vegetable Kingdom only; he works in a still higher world also, and gives a form and a house to millions endowed with animal life. When they die, he gathers together their abandoned home with wonderful care, and builds out of minute, mostly invisible shells, wide plains and towering mountains! Does this not remind one of the enchanted princesses of Eastern tales? Here also there are beings, but beings without number, held in the icy bonds of death, waiting for the day when the great word shall be spoken that will change death once more into life, and sorrow into joy.

Thus, through plants and animals, the pebble has risen, ever brighter, better, and more useful in the great household of Nature. No longer a selfish recluse, he now offers a brother's hand to other elements, and, with their aid, he enters into and builds up himself a higher world. We know that every drop of our spring water contains some little atoms of the pebble, and plant, animal, and man, drink, all alike, with this water, an indispensable element of their life. Man's very body, it is said, holds

flint; he drinks it in his water, and eats it in his lentils, his beans, and his cabbage.

But even this does not satisfy the pebble's ambition. He feels his longing towards light—for even stones, "the whole creation groaneth and travaileth in pain"—not yet satisfied. He presses onward, upward, to the great light of heaven, and, at last, by a new union, becomes light itself, bodily, tangible light.

Phœnician merchants, we are told, in days of old kindled a fire on the sandy shores of Africa, and built a rude hearth of natron, with which they traded. They saw, to their amazement, a beautiful mass, bright and clear, formed in the ashes. The wily merchants carefully gathered the strange pieces and—glass was invented. More recent researches have discovered glass in the cities of the dead of old Egypt, and, if there is no error about it, even ancient Nineveh already knew the precious material.

Thus the humble pebble became the invaluable medium by which we can let light into the dark night of our dwellings. The poor Esquimaux still builds his miserable hut like the beasts of the field, darkening and closing all apertures, to keep out snow and rain, frost and ice. Other nations are reduced to thin layers of horn, which allow a faint light to sift through the opaque material, but soon lose even this transparency under the influence of wind and weather. Better fares the contented peasant of Siberia, who gathers the ample stores of mica around his hut, cuts them into small thin panes, and thus enjoys a doubtful light, equally far from the joyous brightness

of day and the sweet, sleep-bringing coziness of night. Few only could be able to afford the costly luxury of the so-called window-pane muscle of Chinese waters, and yet fewer still ever think of what a true blessing the little pebble is to us in his new form of glass! How vastly superior is—thanks to him—the poorest laborer's hut now to the gorgeous palaces of ancient Rome. Neither the splendid mansions of her senators nor the glorious temples of Athens and Memphis knew the cheap comfort, the simple beauty of glass. Now, poor, indeed, and wretched must be the man who cannot invite the cheerful light of day into his humble dwelling, and yet keep storm and rain, wind and weather at bay. And as light comes, a welcome guest, to his hearth, so his eye can, unimpeded by wickerwork or wooden shutter, as of old, now pass freely beyond the narrow domain of his little home. It can reach far and free into God's beauteous creation, and even the poor, sick sufferer on his couch may gladden his eye with the sight of green trees, and his mind by looking upward into the blue heaven where his great father dwells, that will never forsake him.

It is strange, indeed, that the great value of glass remained so long unacknowledged. It is true that Phœnician and Carthaginian merchant-princes gloried in their large, brilliant glass vases as the costliest jewels they possessed. Nero and Hadrian even yet counted them as by far the most precious treasures of their palaces, and paid nearly half a million for one. To keep their rich wines in glass and to drink the generous fluid out of glass was given only to a few, the richest of the land.

The North of Europe appreciated it still more slowly. The royal palace of rich England could, in the year 1661, boast of glass windows only in the upper stories; the lower were closed with shutters.

Those Phœnicians who first made glass, did certainly not anticipate that they had thus created a charm by which man would hereafter obtain the most signal triumphs in science. They were pleased with its bright coloring, they fashioned it into graceful vessels, they shaped it into a thousand forms, but they knew not that a glance through the glassy pebble would open to their near-sighted eye the wonders of the Universe. With the lens man governs the whole world. He tells the rays of the sun to come and to depart at his bidding; he scatters them as he pleases and he binds them together, until their united strength melts the very stone of stones, the hardest of earthly bodies, the diamond. Near-sighted or far-sighted, he takes a glass and the rays of light are made to fall where he pleases, so that he may see what Nature seemed to have denied him. What a progress is this from the huge, unwieldy glass globe, filled with water, of which Seneca speaks with wonder, and which the Arab Al Hazem perhaps already employed to magnify small objects! Now the general on the battle-field, and the bold sea-captain on the wide ocean, marshal their wide-scattered forces by the aid of their glasses. But the greatest of triumphs it accomplishes in the hands of the Astronomer. The whole world lies before him; with one glance he looks through unmeasured space and into times unknown to man. The secrets of the Universe

are laid open to him; the stars reveal to him the eternal laws of the world, and his mind is lifted up to the Infinite. Step by step the despised pebble thus becomes the teacher of mankind. He tempts the mind of man from invention to invention, he becomes glass, lens, telescope. And he is, perhaps, greater yet when he leads man not to the infinitely great, but to the infinitely small. How diminutive appears the microscope by the side of the gigantic telescope of Lord Rosse! And yet who dare say which is the greater, the world in the blue heavens above, or the world in the drop of water? Truly, the pebble has become light itself; it has shown man two invisible worlds: the great, lost in unmeasurable distance, the small, lost in invisible diminutiveness. The pebble is the restless spirit of the world of stones, that yearneth and travaileth after light. It enters the service of man and, a slave, it becomes his master. It endows him with unknown worlds; it awakes in him living, heaven-inspired thoughts—surely, it is more than "only a pebble!"

II.

Nature in Motion.

"We sleep and wake and sleep, but all things move;
The sun flies forward to his brother sun;
The dark earth follows wheeled in her ellipse;
And human things returning in themselves
Move onward, leading up the golden year."—TENNYSON.

NO vulgar error has perhaps longer prevailed among men, than that of the permanency and immutability of our globe. The world is not at rest. The peace in which our mother earth seems to slumber, is but an illusion: in all nature nothing is ever inactive. The moon around the earth, the earth around the sun, that sun around another great centre, and all the heavenly bodies in one unbroken circle around the throne of the Almighty—all are in restless motion, treading their path in the great world of the Lord and praising his name in never-ceasing anthems.

But even at home, our own great mother earth is not, as many still believe, at rest, and her very foundations are every now and then giving signs of the mysterious

life which is throbbing in this vast globe. Meteoric stones, also, come like aërial messengers from distant, unknown spheres, and speak loudly of the life in spaces unknown to human vision. For stones travel as well as life-endowed organic bodies; they are, in fact, the very oldest travellers on earth of whom we have any knowledge. The mountains are not everlasting, and the sea is not eternal. Thousands of years ago, rocks began to shiver in the fierce cold of the polar regions; even Sweden and Norway, Greenland and Spitzbergen, became intolerable, and they set out on their great journey to the warmer South. But huge, unwieldy travellers as they were, they soon tired and rested awhile in the wide, sandy wastes which stretch through Northern Europe and Asia. Some, the large ones, remained there, bleak, blasted masses of rock, sterile and stern, like grim giants of dark, old ages. Their lighter companions, smaller and swifter, rolled merrily on towards the foot of mountains, and there they also lie, scattered over the plains of Europe and Siberia. Science calls them "erratic" stones, the people know them as "foundlings," for there they are, like lost children, belonging to another climate and a different race from those which surround them. When they travelled, man knows not. It must have been in times of yore, however, when the great Northern Ocean covered yet, with its dark waves, mountain and forest in the very heart of the continent. Other blocks travelled against their will, packed up in snow and ice. Whole islands of ice, we know, were torn off by terrible convulsions from the coasts of Scandinavia; the storm-tossed sea

hurled them into her powerful currents, and thus they were carried southward, bearing on their broad shoulders huge masses of rock that had rolled down upon them from their native mountains. These gigantic guests from the North soon stranded against the mountains of the continent; they melted under a more genial sun, and their burden fell to the ground. When, afterwards, the bottom of this vast sea rose and became dry land, these foreign visitors also rose with it, and found themselves, with amazement, in a southern country, under a southern sun.

How long ago these early travels were made by rock and stone, we know not; but they are by no means at an end. The same process is still going on, even now. The Arctic still sends her children out to dwell in warmer climes, and year after year sees wandering stones come from high, icy regions, and tumble into the Atlantic, or strand on the low shores at the mouth of the St. Lawrence. If the bottom of the sea on the banks of Newfoundland is ever to see the sweet light of heaven, it will be found strewn with mighty rocks from Greenland, and our children's children may yet erect a monument to the great father of our country, hewn out of Greenland stone.

Other rocks are sea-born. Lofty mountains, now capped with snow and wrapped in clouds, bear unmistakeable evidence that they once dwelt at the very bottom of the ocean. Sandstone blocks, piled up high until they form large mountain chains, on which gigantic trees are deeply rooted, and the birds of heaven dwell, to whose summit

men now painfully climb to look down upon the sunny plain, were once mere loose, fragile sand down in the deep of the sea. They are still mixed with countless shells, the bones of fishes, and a thousand relics of their former home. On the other hand, we know that large tracts of sea-bottom once belonged to the firm land, enjoyed air, light, and warmth, and abounded with life of every kind. But the sea came and buried them in eternal darkness. For the ocean, also, the infinite, is not the same to-day that it was yesterday—it changes form and shape like everything else on earth. The very heart of the earth is restless. Its glow and its pulse are felt through the whole globe, and in its gigantic vigor it seems ever anxious to break the fetters that hold it a captive. For the earth longs to live, to live in communion with the great elements around it—and volcanoes, with their huge, gaping craters, must serve to keep up the desired intercourse between its unknown interior and the atmosphere. Fused, molten stones are thus dragged from their hidden resting-places in the depths of the earth, passed through fiery ovens, and at last, in fierce fury, thrown out of volcanoes, where, as lava streams, they soon become solid, fertile, and fruit-bearing, or form new mountains on land, new islands in the ocean.

Even now, stones still migrate, thanks to their old friends ice glaciers of vast, gigantic size, that move foot by foot. Their motion is slow but sure: the glacier of Grindelwald advances only about twenty-five feet a year, but a signal-post fastened to a large granite block embeded in the Unteraar glacier progressed at the rate of

nearly a thousand feet annually. Thus, stones travel on the back of icy waves from the mountain top to the foot of the Alps, where they form grotesque groups and lofty ramparts, or lie scattered about on the plain, like the giant rocks of Stonehenge.

They have, however, one mode of travel unlike all other kinds of locomotion, and so mysterious that human science has not yet fathomed its nature. Large masses of rock, namely, of truly gigantic dimensions, when by accident they fall into the deep crevices of these glaciers, return with quiet but irresistible energy to the surface, moving slowly steadily upward. Thus, not unfrequently vast pyramids or stately pillars of ice, broken loose from the mother glacier, are seen standing in isolated grandeur and crowned with huge masses of stone. After a while the strange forms change and melt, the rock sinks deeper and deeper, until at last it is lost to sight, deeply buried in snow and ice. Yet, after a time, it reappears above, and the Swiss say, the glacier purifies itself. For, strange as it seems, the glacier does not suffer either block or grain of sand within its clear, transparent masses, and though covered for miles with millions of crumbling stones, with heaps of foliage and debris of every kind—at the foot of the mountain it is so clear and pure, that even the microscope fails to discern the presence of foreign bodies in its limpid waters. What is equally amazing is, that whilst all weighty objects, leaves, insects, dead bodies, stones, or gravel, sink alike into the cold bed, the organic parts decay quickly in the frozen, rigid mass, but the inorganic parts are thrown up again. Years

ago, a horse fell into one of these glaciers; it sank, marking its outline distinctly, until it was seen no more. A year afterwards the clean, white skeleton projected from the top through the clear ice. In the middle of the sixteenth century a succession of long winters, during which immense masses of snow fell, increased the glaciers so much, that they travelled faster and lower than usually, and in their course overwhelmed a little chapel at the foot of the Grindelwald. All was covered, mountains high, with snow and ice, and so remained for years, buried in ghastly silence. But lo! all of a sudden there appeared a black ungainly mass, high up on the glittering field—it was the chapel bell! Pious hands saved it, carried it to a neighboring town, and there the long-buried bell now rings merrily Sabbath after Sabbath.

If stones travel thus by the aid of majestic glaciers slowly downwards, they have to perform their journeys from below upward in much less time. That fierce element which many believe to be still raging under the thin crust which we inhabit, breaks out every now and then through the great safety-valves that nature has provided. Already, Strabo and Pausanias tell us how, nearly three hundred years before Christ, the mountain Methone arose on the Troicenian plain. Ovid, also, describes, in beautiful verses, how a high hill, rigid and treeless, was suddenly seen where once a fair plain had been spread out. He traces it to vapors shut up in dark caverns below, and seeking, in vain, an outlet through some cleft. The soil began, at last, to heave, he says, and to swell under the pressure of the pent-up heat, until it finally

yielded, and rose to a lofty height. Every age has seen huge rocks and large mountains appear thus unexpectedly on the surface of the globe. In the last century, the volcano of Jorullo rose, in Mexico, 1580 feet above the surrounding plain. The sea, also, has its volcanic mountains, which are of a sudden thrown up from the bottom. The famous island of Santorin, in 1810 still considerably below the surface, was in 1830 only a few feet from it. It appeared as an enormous peak, steep on all sides, but, on the top, presenting the crater of a sub-marine volcano. The igneous nature of the land below is strongly shown by sulphuric vapors, which rise so actively, that ships now anchor there in order to clean their copper thoroughly and quickly. Stromboli, also, was, in like manner, sent up from the deep, to take its place among the islands of the Mediterranean; and, although Italy is now comparatively quiet, still its volcanoes pour forth inexhaustible showers of burning matter, and temporary islands start up now and then from the surrounding sea.

Tremendous in their birth, and gigantic in their effect, these sudden outbreaks can yet not compare, in their permanent importance, with the quiet and almost imperceptible migration of small particles of sand and gravel. Large granite blocks and masses of sandstone, high on lofty mountain tops, are exposed to the varying influence of heat and cold, rain and snow, and crumble, gradually, into coarse-grained sand. Wind and weather, clouds and springs, carry this down, where the restless waves of rivers and streams seize it and hurry it on, through vale and valley, on their long journey, until, at last, they reach

the coast, and throw their burden into the great ocean. Thus, age after age, the loftiest parts of heaven-aspiring mountains are broken to pieces, and swallowed by the ever-hungry sea. There, by their own gravity, and by the weight of the impending waters, they are pressed together, firmly and solidly, until they form new rocks, which human eyes do not see, and which, for thousands of years, may not be called upon to take their place upon the dry land. So that, if the ocean swallows mountains, they, in return, have their revenge, and fill up the sea, slowly and unseen, but with unerring certainty. Such is the might of small things upon earth.

Slow as this process is, its effects are astounding. For, the same abrasion and dilution has been going on for centuries, and gigantic rivers have ever since poured their contents into the ocean. Overcoming all obstacles, rushing, rolling gaily down from their mountain homes, falling over huge precipices, running past rocky ridges, they hurry on without rest and ceasing. Where do they rush to, so eagerly? Towards certain death, in the great ocean! For, no sooner have they reached the distant shore, than their course is arrested—here they drop all the solid parts with which they were loaded, and thus form themselves a barrier against their further progress.

These deposits form shoals and bars; they grow, as year after year brings new additions from the far-off mountains, until hills rise below the surface: the river has to divide, in order to pass them on both sides, and, at last, the increasing sands appear above the water in the shape of a delta. Thus, new land is formed by these

almost invisible particles, and how much is thus dropped may be seen from the river Rhone, which is a thick, muddy stream where it enters the Lake of Geneva, but leaves it a clear, beautiful river. The same process has actually choked up the mouths of the Rhine and the Danube; and the Nile, whose sand-laden waters have literally formed all Lower Egypt with its countless inhabitants and large populous cities, now needs a canal, made by human hands, to find a way and an outlet to the Mediterranean! Our own great river, the Mississippi, becomes, at its mouth, so slow and sluggish, that it can no longer bear up its burden, the immense masses of huge vegetable corpses, the giant trees from the far-off regions, where its sources lie. They sink to the ground, sand and mud fill the interstices up, and they form, here as at the mouths of all large rivers, a peninsula of new, firm land. The Ganges, operating on a still larger scale, pours its gigantic masses far out into the sea: sweet water being lighter than salt-water, they float for some time above the dark green waves of the ocean; but, soon they meet the tide and outside breakers; here they drop their immense loads of sand, mud, and fertile soil, and, in spite of an unusually high tide, form an island more than two hundred miles long.

The power of locomotion is, however, by no means limited to the agency of water and fire alone. Much more remarkable is it, that even without volcanic action —without visible efforts or spasmodic convulsions of our mother earth—whole tracts of land, thousands of square miles large, should move up and down, and, thus, ma-

terially alter the appearance of our globe. It has been said, that there are few places on earth which are ever long at rest; and that, as England, alone, has had its two hundred and fifty-five earthquakes, so some convulsion of the kind is constantly occurring, imperceptible to our senses, but distinctly felt and shown by the delicate instruments which modern science has invented for the purpose. This, however, would not explain the changes alluded to; they are on far too vast a scale to be ascribed to such local disturbances. Almost in every portion of our globe, movement may be observed; the land is either rising or sinking—certainly in slow, but constant motion. Geology teaches us, that this is not a whim of our mother Earth, but that, for long generations, the same change, the same mysterious motion has been going on. It is difficult, only, to observe it, because of its exceeding slowness, as we would in vain hope to mark the progress of the hour-hand in our watches, and yet, finally, see that it has moved. If man could ever, with one vast glance, take in the whole earth—if he could look back into past ages, and, with prophetic eye, gaze into the future, he would see the land of our vast continents heave and sink like the storm tossed sea—now rising in mountains, and then sinking and crumbling, in a short time afterwards to be washed back into the calm impassive ocean. Some of these inexplicable changes have been observed for ages. The whole coast of Asia Minor, from Tyre to Alexandria, has been sinking since the days of Ancient Rome. Northern Russia, on the contrary, has risen as constantly

out of the frozen sea, in which it has been buried since the days when it was the home of those gigantic mammoths that are now found there encased and preserved in eternal ice, to feed with their flesh the hungry natives, and to furnish the world with the produce of strange, inexhaustible ivory mines. Not far from Naples, near Puzzuoli, there are parts of an ancient temple of the Egyptian god Serapis still standing—three beautiful columns, especially, speak of its former splendor. At a considerable height, they present the curious sight of being worm-eaten; and recent, careful researches leave no doubt, that the waters of the Mediterranean once covered them so high as to bring these, their upper parts, within reach of the sea-worms. Since then, the land has risen high; but, stranger still, they are, by a mysterious force, once more to be submerged. Already, the floor of the temple is again covered with water; and a century hence, new generations of molluscs may dwell in the same abandoned homes of their fathers, which are now beyond the reach of the highest waves. An old Capuchin monk, who lives near by, is fond of telling visitors how he, himself, in his youth, had gathered grapes in the vineyards of his convent, over which now fisherboats pass in deep water. Venice, also, the venerable city of the doges, sinks—year after year—deeper into the arms of her betrothed bride, as if to hide her shame and her disgrace in the bosom of the Adriatic. Already in 1722, when the pavement of the beautiful place of S. Marco was taken up, the workmen found, at a considerable depth below, an ancient pavement, which was then far below

water-mark. Now, the Adriatic has again encroached upon the twice raised square; at high-water, magazines and churches are flooded, and if proper measures are not taken in time, serious injury must inevitably follow. Not far from there, at Zara, superb antique mosaics may be seen, in clear weather, under the water: and, on the southern side of the island of Bragnitza, at calm sea, your boat glides over long rows of magnificent stone sarcophagi, far below the clear, transparent surface.

France also bears many an evidence of such changes in place. The unfortunate St. Louis embarked at the spacious port of Aigues Mortes for his ill-fated crusade; the place—a harbor no more—is now at a mile's distance from shore. Only in the last century, in 1752, an English ship stranded near La Rochelle, on an oyster-bank, and was abandoned. Now the wreck lies in the midst of a cultivated field, thirteen feet above sea, and around it the industrious inhabitants have gained over two thousand acres of fertile land in less than twenty-five years. England presents similar instances; thus, the bay at Hithe, in Kent, was formerly considered an excellent harbor; it is now, in spite of great pains and much labor bestowed on it, firm land and very good pasture for cattle.

These gradual and almost imperceptible changes of land have probably been most carefully observed in Sweden, where already, in the times of Celsius, the people believed that the water was slowly withdrawing from the land. The great geologist Buch has since proved that, north of the province of Scania, Sweden is rising at the

rate of from three to five feet a century, whilst south of this line, it is sinking in proportion. Some villages in southern Scania are now three hundred feet nearer to the Baltic than they were in the days of Linnæus, who measured the distance a hundred years ago. Historical evidence abounds as to this mysterious movement of a whole continent; the coasts of Norway and England bear, moreover, ample proof on their surface. Nearly six hundred feet above the actual level, long, clear lines of the former level may be seen, distinctly marked by horizontal layers of shells, not of extinct species, but of such as are still found in the adjoining waters. As we go further south, the land seems to sink: all along the coast of Germany and Holland legends and traditions are found, speaking of lost cities and inundated provinces. The Germans have their songs of the great city of Iduna, in the Northern Sea, the bells of whose churches may still be heard, in dream-like knelling, on a quiet, calm Sabbath-day; and in Holland they tell of the steeples and towers that can be seen in clear weather, far down in the Zuyder Sea. Stern reality shows that these are not idle inventions; it is well-known that great cities, large islands, and whole provinces have actually been engulfed, and in both countries man is even now incessantly at work to protect the sinking shore against the encroaching waves. In Greenland, the level changes so much, and the ocean intrudes so fast, that the Moravian settlers had more than once to move the poles to which they moored their boats, nearer inland. On the low, rocky islands around, and on the mainland itself,

numberless ancient buildings have been submerged, and for ages the inhabitants have ventured no longer to build near the sea-coast.

For the sea also has its strange motions like the firm land—gentle, progressive oscillations which return at stated periods, or act with sudden force. In the South Sea, we are told, the bottom of the sea rises and sinks in regular alternation; the same occurs near the coast of Chili, teaching us by land and by water, the inconstancy of the present order of things, and the changes to which, at great intervals, the outlines of our continents are probably subject. Truly He alone, who is our God, He changes not.

Thus, all is life and motion in the earth, on the earth and around it. What a source of incessant movement is even the sun alone! From the bottom of the ocean it raises high into the air the rivers that are to water the two worlds. The sun orders the winds to distribute them over continents and islands, and these invisible children of the air carry them under a thousand capricious forms from land to land. They spread them across the sky in golden veils and purple hangings; they raise them into huge dark domes, threatening deluge and destruction. They pour them in tempestuous torrents upon high mountains; they let them drop gently upon the thirsty plains. Now they shape them in beautiful crystals of snow, and now shower down pearls of peerless beauty in clear, transparent dewdrops. However whimsical their service seems to be, each part of our globe receives, nevertheless, year by year, only its proper and good pro-

portion. Each river fills its bed; each naiad her shell. And the winds themselves, what busy travellers are not they in their own great realm of the air! They blow where they list and we hear the sound thereof, but we cannot tell whence they come and whither they go. A merry life they lead, these sailors of the air. Now they chase golden clouds high up in the blue ether, and now they descend to rock in merry sport gigantic oaks and Northern firtrees. As pleasant pastime they give life to wandering shadows, wake the slumbering echo, and gather rich perfumes from the flowery meadow. To-day they bend down vast oceans of gracefully waving corn-fields; to-morrow they peep under the branches of trees to look for golden fruit, or they strip them of their leaves to show to man through their bare arms, the blue heavens above. On sultry days they cool themselves in the floods of the ocean, and carry refreshing dew back to the parched land. Passing on their manifold errands, they trace their characters in a thousand ways on the liquid plains of the sea. Some scarcely wrinkle the placid surface, others furrow it deeply with azure waves, or toss it up in raging billows and cover their crests with white foam.

Such are evidences of motion in Inorganic Nature. If organic bodies travel faster and more visibly, they leave, on the other hand, fewer great marks behind them. Rocks, when they wander, remain themselves as milestones, by which we may count the distance from which they came. Men keep in sagas and myths a certain hold on the past, or erect, with their own hands, monuments of

great events. But plants and animals consist, at best, only of perishing individuals, and have no power given them to speak to future ages. What we know, therefore, of their wanderings is little, but even that little gives us such an insight into the inner life and motion of Nature, that it is well worth recording.

Plants have ever travelled most and furthest of all children of this earth. Much has been said and much has been written about poor flowers, these true and genuine children of their mother earth, coming directly out of her bosom, and ever busy to draw from the air of heaven food for their great parent. Often have they been pitied because they are chained to the soil, whilst their own shadow, as in mockery, dances around them and marks the passing hours of sunshine. Trees have been called the true symbols of that longing for heaven which is innate in man's soul. Bound for life to one small spot on earth, they are represented as stretching out widely their broad branches, far beyond the reach of humble roots, trying to embrace the balmy air, to drink in the golden light of the sun, and to arrest the very clouds in their aërial flight.

But in reality plants travel far and fast. It is true, they perform their journeys mostly in the seed; but there is, perhaps, no earthly kind of locomotion which they do not employ for their purpose. Wind and water, the beasts of the field and the winged creatures of heaven, above all, Man himself—all have been pressed into their service, to carry them from sea to sea, and from shore to shore. Countless powers of Nature are incessantly at work to

scatter the blessings of the vegetable world over the nations of the world. Almost one-fourth of all plants upon earth bear seeds that are provided with wings, parachutes, or other contrivances, by means of which they may be carried on the wings of the wind to distant regions. Every brook and every river, even a short-lived rain, carry a thousand plants to remote countries. The great ocean itself, on its mighty currents, bears fruits and nuts from island to island, and every coral reef in the South Sea is almost instantly covered with a rich, luxuriant vegetation.

New plants appear thus constantly, where they were formerly not found, whilst of the disappearance of vegetables there are but few isolated instances known. Thus, Egyptian monuments have in their quaint and well-preserved paintings, three kinds of sea-rose; only two of these are now met with in Egypt or the adjoining countries; the third is not found there or anywhere over the wide world.

The most efficient agent employed by plants for their journeys is man himself. History and science both teach us that the heated air, which, coming from the poles and rushing to the equator, there falls in with the great life-artery of the globe, and in a constant, almost organic current follows the apparent course of the sun from east to west, gives us the direction in which all life and motion proceeds upon earth. This great movement, no doubt as old as the globe itself, and yet the last known to man, is still going on; and whilst history furnishes us with a vast number of well authenticated facts, the pre-

sent day verifies and substantiates them more and more clearly. All good things, it has been truly said, come from the Orient.

Plants also seem to have their common home in the East, from whence they have travelled and scattered in all directions, far and wide. We mean not to speak here of the first epoch in the history of the earth, when islands rose out of a vast chaotic ocean, covered with plants which thence spread over the globe, wandering from the equator to the poles, and from high mountains to humble valleys. We speak not of the days when palm-trees and ferns were buried under the eternal snows of northern seas. Of those grand movements we have as yet too little positive knowledge. But we can follow, in comparatively modern times, the migrations of some plants, step by step, and we always see them travel from the rising towards the setting sun. Coffee and tea, sugar and cotton, bananas and spice, all were first known in the far East, and have, from thence, slowly followed the apparent light to the West. Alexander the Great brought from his expeditions the broad bean and cucumber to Greece, and flax and hemp are of Indian birth.

Most important, however, for the life of man, and therefore his most faithful companions in his own great journeys, are the grasses. It is these which mainly feed him and domestic animals. Tropical regions certainly produce the breadfruit, cocoanut, and date, which support man spontaneously all the year round; but they are bound to and confined within small districts, and cannot be transplanted. Providence, therefore, has endowed some grasses

—and these the most essential to man—with greater flexibility of structure, so that he may carry them with him wherever he wanders. He is, after all, not the master of creation; he cannot at will alter the natural distribution of vegetables, to suit his pleasure or to satisfy his wants. Hence he has been compelled to choose, all over the world, among the four thousand varieties of grasses which adorn our generous earth, some twenty kinds only, which will in one summer, in a few months, produce rich food, independent of the dry heat of the tropics and the rigid cold of the North. It is they which mark the periods in man's history; with them came everywhere civilization in the change from a wandering, pastoral life to the higher grade of permanent agriculture. Thus, the great phases of man's history are written also on the green pages of the vegetable world.

At a very early period already these cerealia must have come from the Eden of God into the fields of man. Their subsequent path may be distinctly traced from nation to nation, but the unfathomable antiquity of their first culture is clearly seen in the fact that, in spite of the most careful researches, the genuine natural home of the more important varieties has never been discovered. Their original source is wrapped in the same mystery which hides the first history of those domestic animals that have accompanied man all over the globe since his earliest migrations. They are, in truth, homeless. After tracing them up through a few centuries, we reach traditions and myths only, which invariably point to the gods themselves as the first givers of these rich

blessings. In India Brahma descended from heaven for that purpose, in Egypt Isis; Greece owed the gift to her Demeter, Rome to Ceres. The ancient Peruvians even had similar legends about the origin of maize, which the bold Spaniards, who invaded their ancient kingdom, found cultivated on sacred ground around the Incas' Temple of the Sun, at an elevation of 12,000 feet above the sea. The ripened grain was solemnly sacrificed to their god or distributed among the people who ascribed to it miraculous powers. But, setting these fables aside, both tradition and history point invariably to the East as the land from which these grasses first came. Myths even lose them on the high table-lands of Asia, where, it has been conjectured, a late and last rise of the land in distant ages, and a sudden elevation of mountains may have scattered them so, that they can no longer be found even in their original fatherland. Now they are met with only cultivated or run wild, and even ancient Sanscrit has no proper word for them, but calls wheat already food of Barbarians, thus indicating its Northwestern origin.

Not all nations, however, can lay equal claim to the distribution of these noble gifts of nature. It is the Caucasian races alone who have caused the migrations of the most important plants from their original home, wherever that may be, to the four quarters of the globe. Europeans have, by degrees, transplanted to their own land all the characteristic plants of other races. They have fetched the finer fruits, the almond, apricot, and peach, from Persia and Asia Minor; they have brought the orange from China, transplanted rice and cotton to

the shores of the Mediterranean, and carried maize and potatoes from America to Europe. But the influence of these races in changing the natural distribution of plants is even more evident in the colonies which they have established abroad. These they have endowed not only with their own vegetables, but also with those which would not flourish in Europe, but might thrive in more favored regions. Thus we find all European corn-plants in every part of America; the vine has been carried to Madeira and the Canaries, to the southern parts of Africa, and America; rice and cotton are raised in vast quantities in the United States and in Brazil; nutmeg and clove have found their way to Mauritius, Bourbon, and the West India Islands, and tea is now cultivated in Brazil, India, and Java. Other races have done but little; the Arabs helped to diffuse cotton, which the ancients already knew in India, and later in Egypt, coffee, sugar, and the date-palm; the Chinese have imported cotton from Hindostan, and the Japanese tea from China.

The earliest grains known in Europe were undoubtedly wheat and barley, although even the oldest authors are at variance as to their first home. Charred grains of both are found in Pompeii, and pictures on the walls of the silent city show quails picking grains out of a spike of barley. The Bible, Homer, and Herodotus, already mention them as widely diffused, and Diodorus Siculus even speaks of the belief entertained by many, that wheat grew wild in the Leontine fields and several other places in Sicily. So certain is it that antiquity itself was at a loss where to fix the original abode of

these grasses; all references, however, point to India, and yet Humboldt tells us, that the varieties there found in our day bear unmistakable evidence that they were once cultivated, and have but recently become outcasts. The Spaniards carried wheat to North America; a negro slave of the great Cortes was the first who cultivated it in New Spain, beginning with three grains which he had accidentally found among the rice brought out as provisions for the army. At Quito, they show to this day, in a Franciscan convent, the earthen vessel which had contained the first wheat sown there by a monk, a native of Flanders, in front of his convent, after cutting down the original forest. The great Humboldt says, justly, in connection with this fact: "Would that the names had been preserved, not of those who made the earth desolate by bloody conquests, but of those who intrusted to it first these, its fruits, so early associated with the civilization of mankind." Barley, which Homer mentions as the food of his heroes' horses, has at least this merit, that it is the most widely spread of all the nutritious grasses. It is known from the utmost boundary of culture in Lapland down to the elevated plains near the equator.

At a much later period, rye was brought to Europe; at the time of Galenus it found its way through Thracia into Greece, and Pliny speaks of it as having been brought from Tauria by Massilian merchants; in his day it was occasionally met with in the neighborhood of Turin. Serbian Wendes brought it, in the seventh century to Germany, where Charlemagne at once distinguished its great importance, and wisely encouraged its culture,

so that it soon spread over the continent, and now sustains at least one-third of its inhabitants. This grass also was apparently found growing wild in the Caucasus, but more careful observations have since shown that the presumed originals were a different species: their stems were so brittle that they could not be threshed. More recently still, oats were brought to Europe from the East, and whilst in Greece they were only used as green fodder, Pliny already represents the Germans as living upon oat groats, a dainty which they have by no means abandoned since.

Rice seems at a very early period of European history to have acquired no small importance among the more widely diffused grasses. Hence we can more easily follow its gradual migrations from its home in India, to which, even the Sanscrit name Vri points, and where the Danish missionary, Klein, believes that he found it growing wild, to various parts of the world. In the East, we know, it was from the times of antiquity the principal article of food; at the time of Alexandar the Great it was cultivated as far as the lower Euphrates, and from thence it was carried to Egypt. The Romans do not seem to have known it. The Arabs, however, brought it, after their great conquests in Africa, Sicily, and Spain, to Southern Europe. North America knows it only since the beginning of the last century, but produces now a large proportion of all the rice consumed in the Old World.

The New World claims maize alone as its own indigenous product among the nutritious grasses. But even

this is not allowed without some opposition. Theophrastus speaks of a certain peculiar wheat, with grains of the size of an olive kernel, which came from India; and many believe that this cannot have been anything else but maize. They try to strengthen their position by the fact, that not one of the many carefully searching travellers in America has ever yet found maize growing otherwise than cultivated or evidently run wild. Its names in European languages certainly refer it to the East. Germany and Italy call it "Turkish wheat," and the Greeks also point with their "Arabic wheat," to an Oriental home.

It is almost cruel not to allow this continent the merit of being, at least, the original home of the potato, as is generally believed. It was said to grow wild in Peru, Chili, and Mexico, but learned botanists and careful observers have since ascertained that the tuber there found is not the common parent, but only a different species of the numerous genus to which the potato belongs. Another curious evidence is, that in Mexico itself, only quite recently, attempts have been made along the coast to raise potatoes, mainly for the purpose of giving to Europeans in the so-called home of that most useful plant, the favorite vegetable of their own mother country. But alas! they have stoutly refused to grow any longer in the presumed land of their fathers, and every effort has, so far, signally failed.

As every great good has its necessary evil, and as every army of brave soldiers is almost inevitably followed by crowds of stragglers and robbers, so man also has been

compelled to take along with these eminently useful grasses their inseparable companions, a whole rabble of weeds, thorns, and thistles. Most of these, as now found in our fields, came, without doubt, with the cerealia. In still larger numbers, however, and without the agency of man, certain other plants attach themselves to the lord of creation and follow him wherever he goes, and builds himself huts. These seem not to be bound to their kinsfolk, the grains and grasses, but to man's own immediate home; they settle with never-failing punctuality around his house, near to his stable, or luxuriate on his dunghill. Travellers can thus trace, as the celebrated Augustin St. Hilaire did in Brazil, by the mere presence of weeds, even in the midst of a desert, the place of abandoned and utterly destroyed settlements. Stranger still is it, that the different races of men have different kinds of weeds following in their wake, so that a careful observer can, in travelling, see at once, by merely noticing the prevailing weeds, whether Europeans or Asiatics, Germans or Slaves, Negroes or Indians, have dwelt at certain places. It was not without good reason, then, that some of our Indian tribes called the common plaintain in their language "the white man's footstep;" a simple but distinct vetch marks in like manner, even now, long after the entire abandonment of the land, the former dwelling places of Norwegian colonists in Greenland. Historians, also, may thus learn yet many a lesson, even from weeds, as to the direction and length of the great migrations of the human race. One of the most remarkable instances of the kind is perhaps the almost universal

dispersion of the deadly night-shade. It came at first from India, whence gipsies carried it over the wide world, making constant use of its medicinal virtues and vices. They always kept it on hand, and even raised it around their encampments, and thus it followed their trace from the far east to the far west.

One peculiar effect of this migration in masses is, that certain plants, first introduced by man, have subsequently become so generally diffused, independent of his agency, as to displace, in some instances, the whole original flora of a country. The rich pampas of South America have thus been overrun with the artichoke and peach-tree of another continent; immense tracts are now covered with these intruders from abroad, and rendered useless as pastures. Even islands have not escaped this fate. In St. Helena, original plants have almost entirely disappeared, and made room for those which have been brought there from Europe and Asia. In eastern China the population is so dense, and the culture of the soil so high, that, with the exception of a few water-plants in skilfully-flooded rice-fields, all the plants which originally grew wild there, have been driven out. The whole land is now exclusively covered with grains raised by the hand of man, and the botanist finds, in the lowlands at least, not a single plant which is not artificially cultivated.

Some plants thus literally conquer a country and banish the native inhabitants; others disappear, not before enemies of their own race, but emigrate because of climatic changes. Palestine, which was once a land flowing with milk and honey, where the grape and the date abounded,

is now utterly sterile. The spoiler is fallen upon her summer fruit and her vintage; joy and gladness are taken from the plentiful field, and her plants are gone over the sea. Our common clover has distinctly marked its travelling-stations; requiring much moisture, it left Greece when her plains were scorched and withered; Italy could not hold it, after repeated devastations, when it made its way into Southern Germany; from thence it is even now gradually wandering towards the moister regions of the North. No Pythagoras need forbid his disciples now the use of the bean, for Egypt is no longer able to produce it. The wine of Mareotis also, that inspired the guests of Cleopatra, and whose praises Horace has sung in such graceful verses, grows no more. The conscience-stricken murderer would find no shelter, in our day, in the pine-forests of Poseidon, where to lie in wait for the guests that wandered joyfully to the great festivals of Greece; the pines have long since left the plain, with its hot, dry climate, and moved up to the cooler mountains.

It need hardly be added, that all the finer fruits, also, have come to us from the East. The precious grape, the cooling cherry, the pomegranate and the peach, in fine all the luscious gifts of Autumn, we owe to the Orient. Italy is not originally

> "The land where the lemon-tree blows,
> In darker leaves bowered the gold orange glows,"

for Seville oranges and lemons came to Europe only through the Arabs. The latter are not even found on the walls of Pompeii, and the common orange, which is

a Chinese by birth, was brought to Europe first by bold Portuguese sailors.

In Europe, these fruits lingered a while, were remodelled from their first rough shape, developed and refined, and then sent, ennobled in shape and quality, across the broad Atlantic. Here they have rapidly spread from State to State, and are even now on their way, through California, back to their original home. The day may not be far distant, when the youthful Union, which has already given grain back to starving Ireland, and loads the tables of the English with the finest apples the world knows, may send its grapes and unsurpassed nectarines to ancient Persia, from whence Europe received the hard, unflavored peach. Strange it is, that as Europe has never returned any similar gifts for the many presents it has received from the East, so America also has given to Europe nothing in return for her many kindnesses. For the whole rich blessing of our grain harvest, for the wholesome rice, the profitable cotton, for sugar and spice, oranges and pomegranates, all of which we owe to the Old World, we have sent back but two rather equivocal gifts. For smokers alone will be disposed to think the introduction of tobacco a real, valuable present. A plant which affords no edible root, fruit, or other nutritious part, distinguished neither by beauty nor by sweet odor; but, on the contrary, by a disagreeable smell and taste; which produces, when eaten, nausea, vomiting, and giddiness, and is, in large quantities or concentrated, even deadly poison —such a plant is surely at least a doubtful gift. So it is with the potato, which has long been considered by its

enthusiastic admirers an incomparably rich gift of the West to the East, but which now might easily be looked upon as the fatal fruit marking in the annals of history the first decline of European nations.

But even tobacco is not accepted as a Western gift by all botanists. Although it is said that the Spaniards found it used in Mexico medicinally, especially in the treatment of wounds, and saw it smoked there, as the English did in Virginia, still it was certainly known as early as 1601 in Java and China, and there is good reason to believe at an even earlier date in China. Now, as tobacco did not reach Europe before 1559, when it was first used in Portugal—and, consequently, in Europe—as medicine, it may at least have been known in Eastern Asia long before the discovery of America. Nature, moreover, seems almost desirous to avenge the unnatural movement from west to east by the rapid degeneration which marks the culture of both these vegetables in Europe. But even if maize really came from this continent first, if the Indian fig and the closely related agave, which now grow wild around the Mediterranean and add so much to its picturesque scenery, have their true home in the New World, these two plants would still be the only ones that have ever travelled eastward, single and isolated exceptions to the great law of Nature, that plants, animals, and men, all must travel towards the setting sun.

This mysterious but undeniable movement is still going on. It proceeds, even in our day, on a grand and imposing scale, and essentially alters, from time to time, the vegetable character of whole countries, as they are newly

discovered or newly settled. It shows us in indelible signs the silent, irresistible force with which humble plants prescribe their path on earth to both the animals that feed us and the different races of men. For such is the strange relation between plants and man: they are of paramount importance for his existence not only, but also for his welfare. It is little to say that they feed and clothe him, and that they enable him to sustain the life of those animals, from whom he receives in return not only food and comfort, but, what is incomparably more valuable, service, affection, and gratitude! The cerealia have become the first, and most binding social tie between men, because their culture and preparation require vast labor and mutual service. As no society, moreover, can exist without laws, it may well be said, that these short-lived grasses are in truth the first cause of all legislation. Not without good reason, then, was it that the Romans called their Ceres not only a goddess, but also a legislator.

To the careless observer, animals seem to be as permanent features in Nature as plants. Apparently the same sparrow picks up grains of wheat in the harvest-field that robbed our cherries in early summer, and the same game which our forefathers hunted, tempts us now in field and forest.

It is, however, not so. The demoralized domestic animals, it is true, are nearly the same now that they ever were; the same sheep of whom "Abel was a keeper," sleep night after night on our pastures, and the "cattle on a thousand hills" rove now on our plains. But all

nobler, higher life among animals, moves restlessly round the globe. Here also there is an incessant going and coming, flying and pushing, an endless change of home, to exchange a used-up past for a promising future.

No class of animals, high or low, escapes entirely the general law of movement, and if we read occasionally of flights of storks and shoals of herrings, these are mere anecdotes, nothing but single, detached features of that unwearied life which moves in grand and restless masses round the terrestrial globe.

Of the earliest migrations of animals, even of those whom man has bound up with his own existence, we know but very little. History, which tells us nothing of man's own first journeys, condescends not to speak of beings less noble. We guess, rather than we know, that the domestic animals at least left their common home in the great centre of all earthly life, Upper India, together with the first migrating nations. We conclude this mainly from the fact that the races of men separated at a time when they were all shepherds. This we know from Language; for in all idioms the words relating to pastoral life are cognate words, whilst in other respects the relationship is far more complicated and difficult to trace. A remarkable instance of this connection is the word "daughter" in German, "tochter," from the Greek θυγατήρ, which is in Sanscrit "duhitri," and there means "milking woman," because we know that it was the custom of all pastoral nations to leave the milking of the herd to the daughter of the owner. The animals themselves maintain a certain connection with their first home

on earth, for most of them have still some wild relations on the high table lands of Middle Asia, where, in primitive fierceness, strength, and beauty, they rove about, and race for hundreds of miles along the valleys to exchange exhausted lands for new rich pastures.

Animals, like plants, travel occasionally by means of the various agents whom nature herself places at their disposal. The giant rivers of the earth, the Ganges, Congo, Amazon, Orinoco, and Mississippi, annually float islands towards the ocean, covered with living inhabitants. Nothing is more common than to meet out at sea, thousands of miles from all land, masses of fucus floating on the surface of the water, and serving as a resting-place for small shell-fish, unable to transport themselves by swimming, far from their native shore. Off the Moluccas and Philippines, sailors often meet, after a typhoon, with floating islands of matted wood, full of life, and covered with large trees, so as to deceive their eyes, and to endanger the safety of their vessels. Trunks of trees, also, are found drifting in the great currents of the ocean, perforated from end to end by the larvæ of insects, and filled with the eggs of molluscs and fishes. At other times they have been known to convey lizards and birds from land to land, and on the island of San Vincent there appeared once a huge boa constrictor, twisted around a large, healthy cedar-tree, with which it had been torn from its home in the primeval forests of Brazil. It swallowed several sheep before it could be killed by the astonished natives. The gulf-stream, it is well known, carried, more than once, dead bodies of an unknown race

with unusually broad faces, to the Azores, and thus contributed to the discovery of our continent by confirming Columbus in his faith in the existence of a New World. Greenlanders and Esquimaux have even been carried alive across the Atlantic, and found themselves, to their amazement, on the coast of England.

Nor are these always individual journeys. Currents of air carry myriads of vegetable seeds, and with them countless eggs of insects and infusoria all over the world. To settle this formerly disputed question, a German philosopher, Unger, placed several plates of glass, carefully cleaned, between the almost air-tight double sashes with which he protected his study against the rigors of a fierce northern climate. Six months later, he took them out and examined the dust that had fallen on them through imperceptible cracks and crevices, with the microscope. The result was, that he discovered, in the apparently inorganic dust, the pollen of eight distinct plants, the seeds of eleven varieties of fungus, the eggs of four higher infusoria, and living individuals of at least one genus!

But larger animals also are thus carried about by as yet little known modes of conveyance. There exist, among others, countless examples, from the oldest times to our own, of mice and rats, insects, fishes, and reptiles being carried off by storms and whirlwinds far from home. Only a few years ago, a long and violent rain in the heart of France brought with it millions of well-sized fishes, which were eagerly devoured by hosts of storks and crows, and other birds, that came suddenly from the four quarters of the wind, to share in the rich and unexpected

repast. Rains of frogs are even more frequent, and have, since the days of Moses, occurred in almost every country.

Far more remarkable, however, are the spontaneous, though casual, journeys of certain animals; as, for instance, those of the almost invisible gossamer of Europe, floating in the air on a silvery thread. They were a marvel to former days, and Chaucer even says—

> "As sore some wonder at the cause of thunder,
> On ebb and flood, on *gosomer*, and mist,
> And on all thing till the cause is wist."

The tiny aëronauts may be seen, on almost any fine day in autumn, spinning a wondrously fine thread, without fastening it, and then letting it waft about, until it is strong enough to carry them. All of a sudden they shoot out their web, and mount aloft, even when no air is stirring. And on these slender threads they travel, we know not how far, for Darwin found, three hundred miles from shore, thousands of these little red sailors of the air, each on its own line, fall down upon his vessel. Various and curious have been the surmises as to the precise nature of their mysterious power to float in the air. As they are mostly observed on misty days, when a heavy dew falls, it has been thought that their filmy thread might get entangled in the rising dew, and by its brisk evaporation be enabled to rise even with the additional weight of the spider. Others have discovered that the little creatures are quite familiar with the laws of electricity, and avail themselves of it for their airy voyages. Their

threads are said to be negative electric, and consequently repelled by the lower atmosphere, but attracted by the higher layers, which are positive. This remains to be proved, and in the meantime, we can but repeat: Hearken unto this; stand still and consider the wondrous works of God!

Among the well-known causes of such spontaneous and irregular migrations, none is so frequent and so all-powerful, as hunger. The wild ass of the steppes of Asia, of whom it was said that, "the wilderness and barren lands are his dwelling," leaves the deserts of Great Tartary, and feeds in summer to the north and east of Lake Aral; in fall they migrate by the thousand to the north of India, and even to Persia. The hare of Siberia, and the rat of Norway, the reindeer, and the musk-ox, all leave at their season the Arctic regions, and travel, impelled by hunger, to southern latitudes. More regular are the lemmings, a kind of Lapland marmot. Scarcity of food, or overpopulation drives them once or twice every twenty-five years, in prodigious bands, from the Kolai and Lapland Alps, one species to the east, another to the west. A terrible scourge, they devastate field and garden, ruin the harvest, and hardly spare the contents of houses. Turning neither to the right nor the left, they march on in a direct, straight line, undeterred by mountain, river, or lake, passing boldly through village and town, until their ranks, thinned by numerous enemies, are lost in dense forests, or they reach the Western Ocean, and there end both their journey and their life. Other bands go through Sweden, and perish in the Gulf of Bothnia, so that but

rarely, and often after an interval of long years, small armies re-unite again and turn their steps once more towards home.

Of the lower animals, molluscs and infusoria travel probably in largest numbers; their hosts are literally countless, and it is well known how they give a peculiar color to large tracts of the ocean.

The most curious circumstance in the life of insects is their migration. They appear in large flights from unknown regions, in places where they have never been seen before, and continue their course, which nothing can check for a moment. They fly, they jump, they even crawl, for hosts of slow, clumsy caterpillars have been met with in the attempt to cross broad rivers. The more disgusting they are, the more persevering seem their labors to fill the earth. The bed-bug, that most hated, and yet most faithful companion of man in all parts of the globe, was not even known in Europe before the eleventh century, when it first appeared in Strasburg, and then, with the beds of exiled Huguenots, was carried to London. The far more useful silkworm, on the other hand, defies all our care and attention, and will not travel beyond the reach of his beloved friend and only food, the mulberry tree, whose leaf has to be destroyed by a vile caterpillar to be changed into bright, beautiful silk. A native of Asia, this worm also was used in China long before any other nation knew of its existence; in the sixth century a monk brought the first eggs in his bosom to Constantinople, and the emperor, Justinian, at once spread the new branch of industry zealously through Greece. When king

Roger of Sicily conquered that land, he carried the silk-worm home with him, as his most precious booty, and introduced it into Sicily. From thence it was, with equal care, carried further North, and finally also to this country.

The bee loves the West so dearly, that it is not found beyond the Ural Mountains, and at the beginning of this century great pains had to be taken to carry it into Siberia. Unknown to America, it had no sooner reached our shores, in 1675, than it spread, with amazing rapidity, all over the continent. "The fly of the English," soon became an abomination of the Indian, because their appearance in the woods was to them a sure sign of the coming of the white man. Even now it leads the great movement towards the West: first is heard the busy humming of the bee, then the squatter's weighty axe, and after him the German's strange jargon.

Ants also have their well-known migrations, and aimless as they seem to be to human eye, blindly as the little insects seem to wander in the dust, still they go as little astray as the countless stars in heaven. The black ant of the East Indies, especially, becomes even useful to man. They travel in countless hordes; the fields are black as far as the eye can reach, and field and forest are left bare behind them. Boldly they enter human dwellings; they sweep over roof and garret, cellar and kitchen; no corner, no crevice, ever so small, remains unexplored, and no rat or mouse, no cockroach or insect can be found after their instinct has moved these not unwelcome guests to continue their march.

Very different are the migrations of the fearful locust,

that ancient symbol of mighty conquerors, laying bare country after country, as an overshadowing and dark cloud, pregnant with the wrath of heaven. Their home is in the far East, in places near the desert. There they deposit their eggs in the sand; when hatched, by the heat of the sun, their young emerge, without wings, from the ground; but when mature, they rise on the first faint breeze that stirs, and fly, under the guidance of a leader, in masses so huge and so dense, that the air is darkened and the sound of their wings heard like the murmur of the distant ocean. In immense flights they travel from the East to the West, penetrating far into the interior of Africa, crossing, apparently without difficulty, the wide waters between Africa and Madagascar, and from Barbary to Italy. They have been seen in the heart of Germany, and a few have even been met with in Scotland. The land is as the garden of Eden before them, and behind them a desolate wilderness, for they destroy all vegetable life with unfailing certainty, and thus often cause famine, whilst the myriads of corpses which they leave behind, poison the air and not unfrequently produce disease and pestilence. Well did the Jews of old know this fierce plague, and well can we understand how the angel of the bottomless pit could appear to the inspired seer in the form of a fearfully armed locust.

On the easiest routes and in the most favorable element for locomotion travel fishes, in incessant movement; even swift birds, in their rapid and unwearied flight, must yield the palm to them, the eagle to the shark, the swal low to the herring. Their form, also, is so particularly

well adapted to swift and easy motion, that the unavoidable resistance of the fluid in which they travel, never seems to impede their progress. While birds, when they undertake long flights, are often obliged to alight, and even try to rest on the yards of vessels, fishes never seem to be exhausted by fatigue and to require respite or repose. Sharks are known to have kept pace with fast-sailing ships during whole long voyages, and to have sported around them as in mockery.

For known and for unknown purposes, in the tiny mountain brook, and in the wide ocean, fishes are seen in unceasing motion, darting in all directions, travelling now single, and now in shoals. Their regular journeys are mostly undertaken for the purpose of spawning; the delicate mackerel moves southward when its time comes, and the beautiful sardine of the Mediterranean goes, in spring, westward, and returns in autumn to the east. The sturgeon of northern Europe is seen singly to ascend the great rivers of the Continent, and the ormul, or migratory salmon of the polar seas, travels, we know not how, through river and lake, up into the Baikal, and there swims, in whimsical alternations, but always in immense crowds, first on the southern and then on the northern bank. The travels of the salmon are probably best known, because the fish was a favorite already in the days of Pliny, and yet, strange enough, is found in every sea in the Arctic, near the equator, and off New Holland, only not in the Mediterranean. They press in large, triangular masses up all the great northern rivers of Europe, Asia, and America. They enter Bohemia with Shakespeare, by

sea, at least, sailing up the river Elbe; they approach Switzerland in the green waters of the Rhine, and even the foot of the Cordilleras by a journey of three thousand miles up the Amazon! Their crowds are not unfrequently so dense that they actually stem, for awhile, the current of mighty rivers; still these bands are formed with great regularity. The strongest and largest females lead—a fact which will rejoice the strong-minded women of our age—followed by others of the same sex, travelling two and two at regular intervals; after them come the males in like order. With a noise like the distant roaring of a storm, they rush up the stream, now sporting in easy, graceful motion, and now darting ahead with lightning speed that the eye cannot follow. Do they come to some rock or wall that impedes their way, they leap with incredible force, and repeat the effort until they have overcome the difficulty; it is even said, that, at the foot of cataracts, they will take their tail in their mouth, and then, suddenly letting it go, like an elastic spring, rise twelve or fifteen feet in the air. Thus they travel on, undismayed and untired, until they have found a suitable place for depositing their eggs, and with the same marvellous instinct return, year after year, to the distant ocean.

It is in their connection with the wants of men, however, that these migrations of fishes become most important and interesting. It is well known that they furnish the sole food of some nations, and contribute in others a vast and cheap supply that covers the table of the poor man with plenty. Migrating fishes are thus one of the greatest and most invaluable gifts of the Creator, by which

thousands support themselves and their families, and which, at certain times, form the exclusive food of whole races, as the sturgeon, upon which all Greek Christians subsist during their long and rigorous fasts. Hence, also, the importance of the herring, a small, insignificant fish, which yet gives food to millions, and employment to not less than three thousand decked vessels, not to speak of all the open boats employed in the same fishery. Where their home is, man does not know; it is only certain that they are not met with beyond a certain degree of northern latitude, and that the genuine herring never enters the Mediterranean, and hence remained unknown to the ancients. In April and June, all of a sudden, innumerable masses appear in the northern seas, forming vast banks, often thirty miles long and ten miles wide. Their depth has never been satisfactorily ascertained, and their denseness may be judged by the fact, that lances and harpoons thrust in between them, sink not and move not, but remain standing upright! Divided into bands, herrings also move in a certain order. Long before their arrival already their coming is noticed by the flocks of sea-birds that watch them from on high, whilst sharks are seen to sport around them, and a thick oily or slimy substance is spread over their columns, coloring the sea in daytime, and shining with a mild, mysterious light in a dark, still night. The sea-ape, the "monstrous chimera" of the learned, precedes them, and is, hence, by fishermen, called the king of the herrings. Then are first seen single males, often three or four days in advance of the great army; next follow the strongest and largest, and after them enor-

mous shoals, countless like the sand on the sea-shore and the stars in heaven. They seek places that abound in stones and marine plants, where to spawn, and like other animals they frequent the localities, to which they have become accustomed, at a regular time, so that they may be expected as surely as the sun rises and sets.

Other fishes have strange peculiarities connected with their travels. Thus, we are told that the mackerels spend their winter in, what would appear to others, a most uncomfortable position. In the Arctic as well as in the Mediterranean, as soon as winter comes, they deliberately plunge their head, and the anterior part of their body, into deep mud, keeping their tails erected, standing straight up. This position they do not change until spring, when they emerge, in incredible numbers, from their hiding-places, and go southward for the purpose of depositing their eggs in more genial waters. Still they are so firmly wedded to this element that they die the instant they are taken out of the water, and then shine with phosphorescent light.

The eel is the strangest of travelling fishes; he even performs journeys on land. In hot, dry summers, when ponds and pools are exhausted, he boldly leaves his home, and winding through thick grass, makes his way, by night, to the nearest water. He is a great gourmand, moreover, and loves young tender peas so dearly that he will leave the river itself and climb up steep banks to satisfy his desire and, alas! to fall into the snares of wicked men. Other fishes travel in large crowds all night long, and a perch in Tranquebar not only

creeps on shore, but actually climbs up tall fan-palms, in pursuit of certain shell-fish, which form its favorite food. Covered with viscid slime, he glides smoothly over the rough bark; spines, which he may sheathe and unfold at will, serve him like hands to hang by, and with the aid of side fins and a powerful tail he pushes himself upward, thus completing the strange picture of fish and shell-fish dwelling high on lofty trees.

In remarkable contrast with this amazing mobility of fishes stands the comparative quiet of Amphibia, which, double-dealing creatures as they are, now claim the dry land as their home, and now the deep waters. The cunning lizard, the creeping snake, the venomous toad, or the voracious crocodile, in fine, all the disgusting animals of this class, whom man looks upon with awe or horror, are fortunately bound to the glebe on which they are born, and of them, as of reptiles, few, if any, love to travel. The violet crab of the West Indies and South America is almost the only one among them all that undertakes long journeys. They live on firm land only, far from the ocean, hid in dark caves or caverns of the mountains. But once in the year, in April or May, the sun, the heat and love penetrate the thick armor of these cold-blooded beings. All of a sudden they burst forth, from cleft and crevice, and move in crowds of hundreds and thousands, so that the ground, the roads and woods are covered with their uncouth shapes. The vast army travels in strict battle array; first come strong men, then the females, in closely packed columns, fifty to sixty yards wide, and often half an hour long. They prefer moving at night, and the

loud rattling of their armor, which sounds like the falling of fierce hail, wakes old and young. During the day they rest at least twice, and hide from the hot sun; with the cool of the evening they set out once more. Instinct shows them the shortest way to the ocean; nothing arrests their march, and they never break their ranks. If rocks or walls impede their way, they scale them with untiring perseverance; if a house blocks up their road, they coolly enter at the open window, frighten for a moment the astonished inmates, but move peaceably out at the other side and pursue their march. If men try to arrest them, they rise with great indignation, stretch out their huge claw, and open and shut it with a loud noise. Only when they are violently frightened they show real alarm, and hurry, in wild, reckless flight, in all directions; they recover, however, very soon, form again at a short distance, and march bravely onward. The injury they do arises much less from what they eat than from the destruction of fields and gardens, in which they trample down and break with their claws everything that is in their way. It is another strange provision of nature, that only few, the strongest, return to their mountain home; by far the largest number are so lean and weak, that they cannot perform the long journey back, and serve to feed the hungry on the sterile beach of the Antilles.

As the liquid wave sustains the rapid fish, so the still lighter air bears the swift bird on broad wings. The number of birds who always remain in the same region is extremely small; by far the most avail themselves of their admirable means of locomotion to go to very great

distances, in order to avoid the hardships of winter, and to exchange the snow-covered fields of the north for the sunny regions of lower latitudes. Some are perfect cosmopolites. The raven is met with, not only throughout Europe, but croaks mournfully on the shores of the Black and the Caspian Seas; he wings his sombre, heavy flight to distant India, and haunts the houses of Calcutta. He forces his way, with daring impudence, over the guarded shores of Japan, dwells a free citizen in the United States, looks with equal gravity into Mount Etna and ice-covered Hecla, and braves the rigor of the Arctic regions as far as Melville Island.

Generally, however, birds have a home, from which they only migrate at stated times, to find a supply of food and a temperature well suited to reproduction. Their admirable powers of motion enable them to circulate, for these purposes, more widely and more freely all over the earth than any other class of animals. In this they are led by the same instincts from the Almighty, that direct alike the life-withering flights of the locust, and the cheerful migrations of the swallow. They are never deceived in their time by any peculiarity of wind and weather; for truly, "the stork in the heavens knoweth her appointed time, and the turtle, and the crane, and the swallow, observe the time of their coming." It even seems as if certain impulses were given to birds, independent of their early imitative propensities, which must proceed directly from the Almighty power that governs the universe. How else could the instinct of migration be felt by birds kept in cages, whom neither cold nor want of food could in-

fluence? And yet birds, who were raised from the egg, who never saw the flight of their brethren, never heard the voice of their companions, will, at the appointed time, become restless, show an insurmountable uneasiness, and when let loose, dart off, as if guided by the compass, to join their unknown friends on their journey. Little, delicate beings, these feeble birds of passage, supported by the hand of Him before whom not one of the sparrows on the house-top is forgotten, bear up against storms of snow and rain, and make their way through such vast turbulence as would apparently embarrass and retard the most hardy and resolute of the winged nation. Yet they keep their appointed time and season, and in spite of frost and winds, return to their station on earth, to gladden and cheer the hearts of men. Besides these birds that visit the temperate zone during the more genial parts of the year and add so greatly to the beauty and music of our groves, in spring and summer, there are others, and those a numerous tribe, that wing their way to the same regions when the reign of winter has commenced. When the Arctic seas, and lakes and rivers present an unbroken field of impenetrable ice, various waterfowl, swans, geese, and ducks, and an infinite number of others seek a warmer climate to the south. In their travels each variety of birds has not only its own appointed time, but also its own peculiar way of arranging their vast armies. Some fly singly, and some in groups, others migrate in thousands. Most travel by day; a few only at night, so that they have been found dead in light-houses, having flown against the dazzling light. Wild geese fly in long lines,

swans in the shape of a wedge, and swallows in broad ranks; starlings roll on in large crowds, constantly whirling around an axis in the centre of their body, and all

> "—— ranged in figure, wedge their way and set forth
> Their airy caravan, high over seas
> Flying, and over lands with mutual wing
> Easing their flight."

Even feeble, ill-winged birds follow the all-powerful impulse, and traverse vast seas and continents as best they can. The Virginia partridge, when going north, is so heavy on the wing, that many fall into the rivers and end their journey by swimming. But of all birds the quail proceeds, probably, in the most peculiar manner. When they wish to leave Europe for Africa, they wait patiently for a strong northwestern wind; as soon as this sets in they start, and flapping one wing, while they present the other to the gale, half oar half sail, they graze the billows of the Mediterranean with their fat, heavy rumps, and bury themselves in the sands of Africa, that they may serve as food to the famished inhabitants of Zara. On other journeys, when they have to pass over land, they make their way running and hopping, until they reach the shore. Tired and exhausted, the weary rest on the rigging of ships, or make regular stations in the Mediterranean, on Malta and the Lipari islands; in the northern seas, on Heligoland and Norderney, so that the inhabitants of these places depend upon a large harvest of quails, like the Jews of old, as a condition of their existence. In Heligoland there prevailed, we are told, the quaint usage, that the preacher in his pulpit, when he saw from his elevated

station, a flock of quails approach, immediately broke off his sermon with the words: Amen! my dear brethren, the quails are coming!

Famous are also the flights of storks, who have their summer-houses high up in the north of Europe, on the roof of the poor peasants' huts, and live during winter, in stately pride, on pyramid and mosque. Cranes, likewise, and herons, travel in fall to the warmer south; when they take wing, their clang is heard from afar, and they rise so high up in the air, that the eye cannot reach them, and we only hear their rough voices, for they do not fly in silence, as most other birds, but utter constant cries, especially when travelling at night, to keep the scattering flock together.

Among the most remarkable migrations of birds are those of the North American pigeon, the very "herrings of the air," as they have, most unpoetically, been called. Like them, however, they appear in astounding numbers, nobody knows whence, and are found alike all over this continent, from Hudson's Bay to the Gulf of Mexico, and from the Atlantic to the Pacific. About broodtime, they unite in millions to seek a comfortable home. Their numbers are far beyond all computation; they darken the heavens with their vast armies, and break down the forests on which they settle. Not less strange is the inexplicable faculty which other pigeons possess, to find the way to their home. Birds have been taken, that had never been further from the place of their birth than a few miles; they were carried by rail to the distance of more than a thousand miles, and then let loose. They were seen

to fly around a few times in large circles, and then, in a straight line, with marvellous swiftness, directly to their home! They cannot see it, for the roundness of the globe would prevent that; no other sense can possibly come to their aid, and yet they never fail to reach the place from which they were taken!

Thus birds travel from land to land all over the earth; some sailing high in the air, passing without astonishment over populous cities, disdaining fertile valleys and plains covered with rich grain, bent with fixed purpose upon the way to their last year's home; others, like the swallow, gladdening both Europe and Africa, and, at the appointed time, leaving their nest to seek a warmer climate, as the soul is anxious to leave this earthly home to seek a better world above. The tender nightingale travels, both sexes together, from north to south; but in early spring the females leave several weeks earlier, and wing their way from Egypt and Syria, alone, to northern regions. Of finches, the females only migrate, the males remain behind, and being thus widowers during the long winter, have, from the French, received the name of *célibataires*. Not inaptly has, therefore, the question been asked, whether the females of birds are not, perhaps, more sensitive to the magnetic current that whirls around our globe, than the males?

The Mammalia do not roam and rove so much as the lighter birds and favored fishes; they are generally bound to certain localities, and at all events chained to the soil. Still we find among them also travellers, now driven forth by hunger, and now by an overwhelming number of beasts

of prey, to seek new pastures and new dwelling-places. Others, again, follow man in his migrations over the globe, and thus spread from country to country. To the former, belong the horses which now roam wild on the plains of South America, and travel, at times, thousands of miles. The wild asses, also, in the wilderness, "which stand up in the high places and snuff the wind like dragons," travel in bands of two or three hundred, and leave, in winter, the tropics for a still warmer region in the south of Africa. They are called "the Bushman's harvest," for the wild Bushman hunts and consumes what has been left by the royal lion and the hungry vulture, who follow them in their march and feast upon them for a season. Gazelles and antelopes migrate in like manner, and even huge elephants are seen wandering in large herds over the boundless plains of Africa. The shaggy buffalo roams in vast numbers over the prairies of our own continent, and migrates at regular intervals from the north to the south, and from the plain to the mountain. Salt springs are with them the great centre of attraction, but generally their movements seem to be regulated by the state of their pastures. As soon as the fire has spread over a prairie, and is succeeded by a fine growth of tender grass, immense herds are sure to appear. How they discover that their table is spread, we know not; it has been surmised that stragglers from the main body, who have wandered away when food became scarce, may first notice the new growth, and by some mysterious means, communicate the good news to their hungry brethren. Monkeys, also, wander from land to land, when driven

by hunger or fierce enemies; they have even been suspected of passing through a tunnel under the straits of Gibraltar, from Africa to Europe. Their mode of crossing rivers is a beautiful evidence of their ingenuity and instinct. A powerful male seizes a branch that projects over the banks of the stream, and suspends himself by his prehensile tail; another takes hold of him, and so on until they have a row as long as the river is wide. Then they begin to swing the living chain, and continue until the impetus is powerful enough to enable the last one to take hold of a tree on the opposite shore. Over this strange bridge the whole host passes safely; as soon as they are across, the first monkey lets go his hold, the chain swings again, and so they all safely get over large rivers.

The so-called domestic animals travel exclusively by the agency of man, and in his company. It is thus that the horse, a native of the wide steppes of Central Asia, which was not known on this continent before the arrival of the Spaniards, now roams over it in vast herds from Hudson's Bay to Cape Horn. To man we owe it, that the goat climbs our Rocky Mountains, and white, woolly sheep graze on scanty hill-sides, whilst the heavier, slower cattle fatten on rich low grounds, and remind us, in the far backwoods, by the sweet harmonies of their bells, of the neighborhood of men. But here, also, the weeds have come with the good plants. Thus the domestic (!) rat, a native of the Old World, was carried in ships to the Cape, to Mauritius and Bourbon, to the Antilles and Bermuda. An Antwerp ship brought them, 1544, first, to this continent,

where they astonished the good Peruvians so much, that they obtained with them the name of "things that came out of the sea." Now they are rarer in Europe than in America.

The importance of the useful domestic animals cannot be overrated. The very existence of man is bound up with the horse, the ox, and the sheep. Brazil lives almost exclusively by means of her horses and her cattle; and Australia has developed her resources and progressed in civilization only since sheep have been introduced. It is strange, surely, that like the best gifts in the vegetable world, the cerealia, so these domestic animals, also, are presents which the east has sent to the west, and for which no return has yet been made. Here, also, an invisible but insurmountable barrier seems to prevent such an exchange.

What shall we lastly say of the wanderings of man? His history is still darker than that of his servants, and his first home, our Eden, is truly defended, even now, by an angel with a flaming sword. The place where his cradle stood is utterly unknown. The first period of his life is veiled in dark night; only a few brief flashes of light are, by revelation, thrown upon it, which show us but a single moment in a long period, and consequently, barely allow us to guess at the connection, without giving us anything like continuous information.

It is not a little singular that one of the strongest arguments in support of the favorite idea of man's first home, and the unity of his race, is derived from the analogy between him and plants and animals. As the latter

invariably accompany man, and as they all come from the table lands of Central Asia, so, it is said, man also came probably from that portion of our globe, though, without doubt, at a time when the now dry and sterile heights were still the luxuriant, tropical valley of Eden. For geologists tell us we may with good reason presume that these rich low grounds were, by some mysterious convulsion, raised slowly and steadily, and thus the races of men scattered abroad into the adjoining fertile valleys.

When this happened we know not. It must have been far beyond the reach of history, legend, or vague tradition. Even the oldest races of the earth, whose myths, fables, or songs, whose features or language, point to the distant East with greatest certainty, even these found their land already in possession of others.

Thus the Celts, among the oldest nations of Europe, when they arrived from their far eastern cradle, encountered in Europe already nations whose imperfect language, lawless manners, and superstitious faith, showed how long they had been separated from their early home, and from their former intimate communion with the Creator. Nay, these Celts themselves, coming as they did on one of the very first waves of immigration from Asia, were already comparative barbarians, having lost both the culture and the faith of our first fathers. If, then, so little is positively known of the condition of the West of Europe and the ancestors of the present masters of the globe, much less can be gathered as to the state of things in East itself. Still, wherever legends speak, dimly though it be, wherever traditions begin to shed a faint and often de-

ceitful light upon the first condition of powerful nations—everywhere immense hordes of emigrants are seen to pour forth, age after age, from the same common centre in middle Asia. Chinese myths speak of an immigration from the West, about two thousand years before Christ, and the "Vendidad" of the Zendavesta says that the early Persians came under Schemschid from Eastern table-lands down into the "four-cornered" land, their present home.

By far more positive and certain are the traditions of the three greatest races on earth, both on account of the antiquity, and comparative authenticity of their legends, and on account of the intrinsic evidence drawn from the mutual relationship in which they stand to each other.

The Hindoos, whom we venerate as the oldest of known civilized nations, derive their origin from the Northwest, and call "Hindukush" and "Belustag" in their traditions invariably the boundary mountains—behind which their birth-place is hidden.

The Shemitic nations also point to the East as their common home, and to the Ararat as the landmark which divides their first dwelling place from their present residence.

Now, exactly between the Ararat and the Belustag, lies that vast table-land, which most men are disposed to consider the birth-place of the first among men. Both Indian and Shemitic races brought with them to their new dwelling places, not only an indistinct recollection of their former home, but many rich treasures of their former civilization, in one word, a history of their people. These

elements they rapidly developed to a high degree of power and culture, but the latter withered and disappeared as rapidly again, for it was not grown on its native soil, not favored by the sun of their true home. Hence they either ceased to have a real history as the Chinese and the Indians, or they became rude barbarians, as the Shemitic races.

Different, however, was the destiny of the third great family of men, the Indo-Germans, who probably left, last of all children, the paternal house of the East. In millions they poured wave after wave of migrating nations into Europe, the last of which, fortunately, belongs already to historical times, and under the well-known name of the great Migration of Nations, changed completely the whole ethnography of Europe. Still, among all the numerous Indo-German nations, there lives not a single legend connected with the time of their existence in Asia. They seem to have broken with the past for ever, to have utterly abandoned their early home, and perhaps even the civilization which they left behind them. They have devoted themselves, instead, to that grand future, which alone seems to embody, and to realize the great destiny of mankind.

The only great riddle in the history of the migrations of men, to which neither revelation nor science has as yet offered the key, is the origin of the natives of this continent. Surmises abound, from the most absurd to the most plausible. The poor redskins have been, at will, transformed into exiled Jews or banished Chinese; their language has been called Syriac, Welsh, and Celtic. Their

traditions speak simply and vaguely first of a rude, original race which lived in the fertile plains of the West, and of a more powerful and more civilized race which, at a later period, came from the North, moved victoriously southward, and subjugated the early owners of the soil. The difference of the two contending races is confirmed by the study of their skulls. But we know not whence the native settlers came, nor whence the foreign invaders. It is conjectured, and with good reason, that as this continent is geologically older than that of Europe, so its occupation, also, dates from times previous to the Christian history of the Old World. In those days, however, the nations of Asia are invariably represented as leading a pastoral life, and as having, consequently, long domesticated the ox and the sheep. It is, then, in the highest degree improbable that emigrants of those times, should have left these incalculable blessings behind them, if, as many believe, they went from Asia by a northwest passage across the Atlantic to America. Yet, no trace of domestic animals was found here. As improbable, however, is it that, if by accident they should have been compelled to leave them behind, they should not at once have set to work, in continuance of ancient custom, to tame the buffalo, the vicuña, and the alpaca, as the Europeans did when they arrived on this continent.

Setting this only great riddle aside, and resuming all that myths, traditions, and revelation itself, tell us, so much only seems to be certain, that all migrations of men, like those of plants and animals, have gone from the rising to the setting sun. Everywhere history begins with

an immigration of eastern races. In southern Europe appeared the seafaring Pelasgi; they were soon followed by the Etruscans; then came the Helleni. From the table-lands of the Waldai we see next the Istuni or Fins driven westward by the pressure of countless Teutons. The latter, together with Slaves, soon rush into Scandinavia, Germany, and France. The same phenomenon, in fact, is constantly repeated. New waves of new nations roll on from the East, and shake the foundations of older, well organized kingdoms, until Columbus opens the western gate to let loose the rising stream of Asiatic races, which now flood the new continent.

This resistless movement toward the West is yet unbroken, unrelenting. The same great law of nature impels man towards the setting sun, and all his efforts to travel eastward have been ingloriously foiled. In vain did millions of brave, pious men rush to the Orient to reconquer the Holy Land; in vain were the most chivalrous courage, the most devoted self-sacrifice, employed against the stern eternal rule of nature. No great expedition to the East has ever been successful and permanent. Vast distances have been traversed, vast reverses sustained, and hardships incredible endured—only to result in grand defeats, like the Anabasis of the younger Cyrus, and the retreat of the noble ten thousand. And so it is, still, in our day. As recently as the latter part of the last century, a whole Tartar nation, several hundred thousands of Kalmucks, with all their herds, left southern Russia, and fled across the boundless steppes of Asia, to escape the iron rule of the Russian sceptre. They left unimpeded; they were

allowed to defy their master's vengeance—but they could not disobey the great law of nature. A few beggars returned, long years after, to report that the whole tribe had perished, a whole nation had disappeared from the globe! And the same law called to Napoleon, when he was at the height of his power, sternly uttering the Scripture words: Hitherto shalt thou come but no further!

III.

The Ocean and its Life.

"How sweet . . . .
With half-dropt eyelids still,
Beneath a heaven dark and holy,
To watch the long, bright river draw in slowly
His waters from the purple hill—
To hear the emerald-colored water falling
Thro' many a woven acanthus-wreath divine!
Only to hear and see the far-off sparkling brine,
Only to hear were sweet."—TENNYSON.

HIGH on the terrible cliff that overhangs the Scylla of the ancients stood King Frederick of Sicily; and by his side the fairest of Europe's fair daughters. Often and often had he gazed down into the fierce seething cauldron beneath him, and in vain had he offered the gold of his treasure and the honors of his court to him who would dive into the whirlpool and tell him of the fearful mysteries that were hid beneath the hissing, boiling foam. But neither fisherman nor proud knight had dared to tempt the God of mercy, and to venture down into the dread abyss, which threatened death, sure, inevitable death, to the bold in-

truder. But better than gold and honor, is fair maiden's love. And when the king's beautiful daughter smiled upon the gazing crowd around her, and when her sweet lips uttered words of gentle entreaty, the spell was woven, and the bold heart found that would do her bidding, forgetful of worldly reward, and alas! unmindful, also, of the word of the Almighty!

He was a bold seaman, and his companions called him Pesce-Colo, Nick the Fish, for he lived in the ocean's depths, and days and nights passed, which he spent swimming and diving in the warm waters of Sicily. And from the very cliff on which the king had spoken his taunting words, from the very feet of his fair tempting child, he threw himself down into the raging flood. The waters closed over him, hissing and seething in restless madness, and deeper and darker grew the fierce whirlpool. All eyes were bent upon the gaping gulf, all lips were silent as the grave. Time seemed to be at rest; the very hearts ceased to beat. But lo! out of the dark waves there arises a snow-white form, and a glowing arm is seen, and black curls hanging down on the nervous neck of the daring seaman. And, as he breathes once more the pure air of heaven, and as his eyes behold once more the blue vault above him, he stammers words of thanks to his Maker; and a shout arose from cliff to cliff, that the welkin rang, and the ocean's roar was hushed.

But when their eyes turned again to greet the bold man who had dared what God had forbidden, and man had never ventured to do, the dark waters had closed upon him. They saw the fierce flood rush up in wild

haste; they saw the white foam sink down into the dark, gloomy gulf; they heard the thundering roar and the hideous hissing below; the waters rose and the waters fell, but the bold, daring seaman was never seen again.

Legend recites the fearful tale, and the poet repeats it in melodious strains. But it is neither fable nor fiction. The same dread mystery broods yet over the waters, and little is even now known of the great deep, where the hungry ocean demands still its countless victims. For the calm of the sea is a treacherous rest, and under the deceitful mirror-like smoothness reign eternal warfare and strife. Oceanus holds not, as of old, the Earth, his spouse, in quiet, loving embrace; our sea-god is a god of battles, and wrestles and wrangles in never-ceasing struggle with the firm continent. Even when apparently calm and slumbering, he is moving in restless action, for "there is sorrow on the sea, it cannot be quiet." Listen, and you will hear the gentle beating of playful waves against the snowy sands of the beach; look again, and you will see the gigantic mass breathe and heave like a living being. No quiet, no sleep, is allowed to the great element. As the little brook dances merrily over rock and root, never resting day and night, so the great ocean, also, knows no leisure, no repose.

It is not merely, however, that the weight of the agitated atmosphere presses upon the surface of the vast ocean, and moves it now with the gentle breath of the zephyr, and now with the fierce power of the tempest. Even when the waters seem lashed into madness by the raging tornado, or rise in daring rebellion under the sud-

den, sullen fury of the typhoon, it is but child's play compared with the gigantic and yet silent, lawful movement, in which they ascend to the very heavens on high, where "He bindeth up the waters in His thick clouds," and then again sink uncomplaining to the lowest depths of the earth.

As the bright sun rests warm and glowing on the bosom of the cool flood, millions of briny drops abandon the mighty ocean and rise, unseen by human eye, borne on the wings of the wind, up into the blue ether. But soon they are recalled to their allegiance. They gather into silvery clouds, race around the globe, and sink down again, now impetuously in a furious storm, bringing destruction and ruin, now as gentle rain, fertilizing and refreshing, or more quietly yet, as brilliant dew pearls, glittering in the bosom of the unfolding rose, and filling each tiny cup held up by leaf and blossom. Eagerly the thirsty earth drinks in the heavenly gift; in a thousand veins she sends it down to her lowest depths, and fills her vast invisible reservoirs. Soon she can hold the rich abundance of health-bringing waters no longer, and through cleft and cliff they gush joyfully forth as merry, chattering springs. They join rill to rill, and rush heedlessly down the mountains in brook and creek, until they grow to mighty rivers. Thundering over gigantic rocks, they leap fearlessly down lofty precipices, or gently rolling their mighty masses along the inclined planes of lowlands, become man's obedient slaves, and carry richly laden vessels on their broad shoulders, until they return once more to the bosom of their common mother, the great ocean.

How quietly, how silently nature works in her great household! Unheard and unseen, these enormous masses of water rise up from the broad seas of the earth, and yet it requires not less than one-third of the whole warmth which the sun grants to our globe, to lift them up from the ocean to the region of clouds. Raised thus by forces far beyond our boldest speculations, and thence returning as blessed rain, as humble mill-race, or as active, rapid high-road, carrying huge loads from land to land, the ocean receives back again its own, and thus completes one of its great movements in the eternal circle through water, air, and land.

But the mighty ocean rests not even in its own legitimate limits. When not driven about as spray, as mist, as rain, when gently reposing in its eternal home on the bosom of the great earth, it is still subject to powerful influences from abroad. That mysterious force which chains sun to sun, and planet to planet, which calls back the wandering comet to its central sun, and binds the worlds in one great universe, the force of general attraction, must needs have its effect upon the waters also, and under the control of sun and moon, they perform a second race around the globe on which we live.

When the companions of Nearchus, under Alexander the Great, reached the mouth of the Indus, nothing excited their amazement in that wonderful country so much as the regular rise and fall of all the ocean—a phenomenon which they had never seen at home, on the coasts of Asia Minor and Greece. Even their short stay there sufficed, however, to show them the connection of this astonishing

change with the phases of the moon. For "sweet as the moonlight sleeps upon this bank," it is nevertheless full of silent power. Stronger even than the larger sun, because so much nearer to the earth, it raises upon the boundless plains of the Pacific a wave only a few feet high, but extending down to the bottom of the sea, and moves it onwards, chained as it were to its own path high in heaven. Harmless and powerless this wave rolls along the placid surface of the ocean. But lands arise, New Holland on one side, southern Asia on the other, and the low but immensely broad tidal wave is pressed together and rises upwards, racing rapidly round the sharp point of Africa. Quickly it reaches Fez and Morocco; a few hours later it passes through the Straits of Gibraltar, and along the coast of Portugal. From thence it rushes, with increased force, into the Channel and past the western coast of England. There the rocky cliffs of Ireland, and the numerous islands of the northern seas, arrest its rapid course, so that it reaches Norway only after an eight hours' headlong race. Another branch of the same wave hurries along the eastern coast of America, in almost furious haste, often amounting to one hundred and twenty miles an hour; from thence it passes on to the north, where, hemmed in on all sides, it rises here and there to the enormous height of eighty feet. Such is not rarely the case in the Bay of Fundy—a circumstance which shows us forcibly the vast superiority of this silent, steady movement over that of the fiercest tempest. For even at that most stormy and most dreaded spot on earth, Cape Horn, all the violence of raging tem-

pests cannot raise the waves higher than some thirty feet, nor does it ever disturb the habitual calm of the ocean below the depth of a few fathoms, so that divers do not hesitate to stay below, even when the hurricane rages above. Gentle in its appearance, though grand in its effect, this mighty wave shows its true power only when it meets obstacles worthy of such effort. Where strong currents oppose its approach, as in the river Dordogne, in France, it races in contemptuous haste up the daring stream, and reaches there, for instance, in two minutes, the height of lofty houses. Or it rolls the mighty waters of the Amazon river into huge dark masses of foaming cascades, and then drives them steadily, resistlessly upwards, leaving the calm of a mirror behind, and sending its roar and its thunder for miles into the upland.

Still less known and less observed is the third great movement which interrupts the apparent calm and peace of the ocean. For here, as everywhere, movement is life, as rest would be death. Without this ever-stirring activity in its own bosom, without this constant moving and intermingling of its waters, the countless myriads of decaying plants and animals which are daily buried in the vast deep, would soon destroy, by their mephitic vapors, all life upon earth. This greatest of all movements, never resting, never ending, is the effect of the sun and the heat it generates. Like all bodies, water also contracts, and consequently grows heavier as the temperature sinks; but only to a certain point, about three degrees Reaumur. This is the invariable warmth of the ocean at a depth of three thousand six hundred feet, and below that. If

the temperature is cooler, water becomes thinner again and lighter, so that at the freezing point, as ice, it weighs considerably less than when fluid. The consequence of this peculiar relation of water to heat produces the remarkable result, that in the great ocean an incessant movement continues: up to the above mentioned degree of heat, the warmer and lighter water rises continually, whilst the cooler and heavier sinks in like manner; below that point the colder water rises and the warmer part descends to the bottom. Hence, the many currents in the vast mass of the ocean; sometimes icy cold, at other times warm, and even hot, so that often the difference between the temperature of the current and that of the quiet water by its side, is truly astonishing. The great Humboldt found at Truxillo the undisturbed waters as warm as twenty-two degrees, whilst the stream on the Peruvian coast had but little more than eight degrees, and the sailor who paddles his boat with tolerable accuracy on the outer line of the gulf-stream, may dip his left into cold and his right into warm water.

Greater wonders still are hidden under the calm, still surface of the slumbering giant. Thoughtless and careless, man passes in his light fragile boat, over the boundless expanse of the ocean, and little does he know, as yet, of the vast plains beneath him, the luxuriant forests, the sweet, green meadows, that lie stretched out at the foot of unmeasured mountains, which raise their lofty peaks up to his ship's bottom, and of the fiery volcanoes that earthquakes have thrown up below the waves.

For the sea, also, has its hills and its dales; its table-

lands and its valleys, sometimes barren, and sometimes covered with luxuriant vegetation. Beneath its placid, even surface, there are inequalities far greater than the most startling heights on the continents of the earth. In the Atlantic, south of St. Helena, the lead of the French frigate Venus, reached bottom only at a depth of 14,556 feet, or a distance equal to the height of Mount Blanc; and Captain Ross, during his last expedition to the South Pole, found no bottom yet at 27,600 feet, a depth equal to more than five miles, so that there the Dawalaghiri might have been placed on top of Mount Sinai, without appearing above the waters! And yet, from the same depth, mountains rise in cliffs and reefs, or expand upwards in broad, fertile islands.

Nor can we any longer sustain the ancient faith in the stability of the "*terra firma*," as contrasted with the ever-changing nature of the sea. Recent discoveries have proved, on the contrary, that the land changes, and the waters are stable! The ocean maintains always the same level; but, as on the great continents, table-lands rise and prairies sink, so does the bottom of the sea rise and fall. In the South Sea this takes place alternately, at stated times. To such sinking portions of our earth belongs, among others, New Holland. So far from being a new, young land, it is, on the contrary, with its strange flora, so unlike that of the rest of the world, and its odd and marvellous animals, an aged, dying island, which the ocean is slowly burying, inch by inch.

And a wondrous world, is the world of the great sea. There are deep abysses, filled with huge rocks, spectral

ruins of large ships, and the corpses of men. There lie, half covered with lime and slime, the green, decaying gun, and the precious box, filled with the gold of Peru's snow-covered Alps, by the side of countless skeletons, gathered from every race and every clime. There moulders the bald skull of the brave sea captain, by the side of the broken armor of gigantic turtles; the whaler's harpoon rests peaceably near the tooth of the whale; thousands of fishes dwell in huge bales of costly silks from India, and over them pass, in silent crowds, myriads of diminutive infusoria; enormous whales, and voracious sharks, chase before them thickly packed shoals of frightened herrings. Here, the sea foams and frets restlessly up curiously-shaped cliffs, and oddly-formed rocks; there, it moves sluggishly over large plains of white, shining sand. In the morning, the tidal waves break in grim fury against the bald peaks of submarine Alps, or pass, in hissing streams, through ancient forests on their side; in the evening, they glide noiselessly over bottomless abysses, as if afraid, lest they, also, might sink down into the eternal night below, from which rises distant thunder, and the locked up waters roar and rage like evil spirits chained in the vast deep.

The ocean is a vast charnel house. There are millions and millions of animals mouldering, piled up, layer upon layer, in huge masses, or forming mile-long banks. For no peace is found below, and under the thin, transparent veil, there reigns endless murder, wild warfare, and fierce bloodshed. Infinite, unquenchable hatred seems to dwell in the cold, unfeeling deep. Destruction alone maintains

life in the boundless world of the ocean. Lions, tigers, and wolves, reach a gigantic size in its vast caverns, and, day after day, destroy whole generations of smaller animals. Polypi and medusæ, in countless numbers, spread their nets, catching the thoughtless radiati by tens of thousands, and the huge whale swallows, at one gulp, millions of minute, but living creatures. The swordfish and the sea-lion hunt the elephant and the rhinoceros of the Pacific, and tiny parasites dart upon the tunny fish, to dwell in myriads in his thick layers of fat. All are hunting, killing, murdering; but the strife is silent, no war-cry is heard, no burst of anguish disturbs the eternal silence, no shouts of triumph rise up through the crystal waves to the world of light. The battles are fought in deep, still secresy; only now and then the parting waves disclose the bloody scene for an instant, or the dying whale throws his enormous carcass high into the air, driving the water up in lofty columns, capped with foam, and tinged with blood.

Ceaseless as that warfare is, it does not leave the ocean's depths a waste, a scene of desolation. On the contrary, we find that the sea, the most varied and the most wonderful part of creation, where nature still keeps some of her profoundest secrets, is teeming with life. "Things innumerable, both great and small, are there." It contains, especially, a most diversified and exuberant abundance of animal life, from the microscopic infusoria, in inconceivable numbers, up to those colossal forms which, free from the incumbrance of weight, are left free to exert the whole of their giant power for their enjoyment. Where the

rocky cliffs of Spitzbergen and the inhospitable shores of Victoria land refuse to nourish even the simplest, humblest lichen, where no reindeer is ever seen, and even the polar bear finds no longer a home, there the sea is still covered with fuci and confervæ, and myriads of minute animals crowd its life-sustaining waves. Naturally, the purest spring-water is not more limpid than the water of the ocean; for it absorbs all colors save that of ultramarine, which gives it the azure hue vying with the blue of heaven. It varies to be sure, with every gleam of sunshine, with every passing cloud, and when shallow, it reflects the color of its bed. But its brightest tints, and strangest colors, are derived from infusoria and plants. In the Arctic Sea, a broad band of opaque olive green passes right through the pure ultramarine; and off the Arabian coast, we are told, there is a strip of green water so distinctly marked, that a ship has been seen in blue and green water at the same time. The Vermillion Sea of California, has its name from the red color of vast quantities of infusoria, and the Red Sea of Arabia changes from delicate pink to deep scarlet, as its tiny inhabitants move in thicker or thinner layers. Other masses of minute creatures tinge the waters round the Maldives black, and that of the Gulf of Guinea, white.

When Captain Ross, in the Arctic Sea, explored the bottom of the sea, and dropped his lead to a depth of six thousand feet, he still brought up living animalcula; and even at a depth exceeding the height of our loftiest mountains, the water is alive with countless hosts of diminutive phosphoric creatures, which, when attracted to the

surface, convert every wave into a crest of light, and the wide ocean into a sea of fire. It is well known that the abundance of these minute beings, and of the animal matter supplied by their rapid decomposition, is such, that the sea water itself becomes a nutritious fluid to many of the largest dwellers in the ocean. Still, they all have their own homes, even their own means of locomotion. They are not bound to certain regions of that great country below the ocean's waters. They travel far and fast; currents, unknown to man, carry them, in vast masses, from the Pole to the Equator, and often from Pole to Pole, so that the whale must travel, with locomotive speed, to follow the medusæ of the Arctic to the seas of the Antilles, if he will not dispense with his daily food. How strange a chase! The giant of the seas racing in furious haste after hardly visible, faintly colored balls of jelly!

But, for other purposes, also, there is incessant travel going on in the ocean's hidden realm. Water is the true and proper element of motion, Hence, we find here the most rapid journeys, the most constant changes from zone to zone. No class of animals travel so much and so regularly as fish, and nowhere, in the vast household of nature, do we see so clearly the close relation between the wants of man, and the provision made for them by a bountiful Providence. The first herrings that appeared in the waters of Holland, used to be paid for by their weight in gold, and a Japanese nobleman spent more than a thousand ducats for a brace of common fish, when it pleased his Japanese majesty to order a fish dinner at his house

in the depth of winter, when all fish leave the coasts of his country.

Now singly, now in shoals, fish are constantly seen moving through the ocean. The delicate mackerel travels towards the south, the small, elegant sardine of the Mediterranean, moves, in spring, westward, and returns in fall to the east. The sturgeon of northern seas, sails lonely up the large rivers of the continent of Europe, and has been found in the very heart of Germany, under the shadow of the famous cathedral of Strasburg. Triangular masses of salmon press up nearly all northern rivers, and are sometimes so numerous, so closely packed, that they actually impede the current of large rivers. Before their arrival, countless millions of herrings leave the same waters, but where their home is, man has not yet found out. Only in the spring months there suddenly appear vast banks of this remarkable fish, two or three miles wide, and twenty to thirty miles long, and so dense are the crowds, so great their depth, that lances and harpoons—even the sounding lead—thrown at random amongst them, do not sink, but remain standing upright. What numbers are devoured by sharks and birds of prey, is not known; what immense quantities are caught along the coast, to be spread as manure on the fields inland, is beyond all calculation; and yet it has been ascertained that over a thousand millions alone, are annually salted for winter consumption!

The life of the ocean is gigantic in numbers not only, but also in all its dimensions. Whales of a hundred feet length and more, are the largest of all animals on earth,

five times as long as the elephant, the giant of the firm land. Turtles weighing a thousand pounds, are found in more than one sea. The rocky islands of the southern Arctic alone, furnish a yearly supply of a million of sea-lions, sea-cows, and seals. Huge birds rise from the foam-covered waves, their homes never seen by human eye, their young ones bred in lands unknown to man. Islands are formed, and mountains raised, by the mere dung of generations of smaller birds. And yet nature is here also greatest in her smallest creations. For how fine must, for instance, be the texture of sinews and muscles, of nerves and blood-vessels, in animals that never reach the size of a pea, or even a pin's head!

The ocean has not only its mountains and plains, its turf moors and sandy deserts, its rivers and sweet springs, gushing forth from hidden recesses, and rising through the midst of salt water, but it has also its lofty forests, with luxuriant parasites, its vast prairies and blooming gardens; landscapes, in fine, far more gorgeous and glorious than all the splendor of the firm land. It is true that but two kinds of plants, algæ or fucus, prosper upon the bottom of the sea, the one a jointed kind, having a threadlike form, the other jointless, and comprising all the species that grow in submarine forests, or float like green meadows in the open sea. But their forms are so varied, their colors so brilliant, their number and size so enormous, that they change the deep into fabulous fairy gardens. And, as branches and leaves of firm, earth-rooted trees, tremble and bend on the elastic waves of the air, or wrestle, sighing and groaning, with the tempest's fury,

so "the seaweed, slimy and dark, waves its arms, so lank and brown," and struggles with the ocean, that pulls at its roots, and tears its leaves into shreds. Now and then the mighty adversary is victorious, and rends them from their home, when they wander homeless and restless, in long, broad masses, towards the shores of distant lands, where often fields are found so impenetrable, that they have saved vessels from shipwreck, and many a human life from the hungry waves.

These different kinds of fucus dwell in various parts of the ocean, and have their own, well-defined limits. Some cling with hand-like roots so firmly to the rocky ground that, when strong waves pull and tear their upper parts, they often lift up gigantic masses of stone, and drag them, like huge anchors, for miles and miles. Most of them, however, love the coast, or, at least, a firm sea bottom, and seldom thrive lower than at a depth of forty fathoms. Still, they are found in every sea; the most gigantic, strangely enough, in the two Arctics, where they reach the enormous length of one thousand five hundred feet. Occasionally, they cover vast portions of the sea, and form those fabulous green meadows on deep, azure ground, which struck terror in the hearts of early navigators. The largest of these, called the Sargossa Sea, between the Azores and the Antilles, is a huge floating garden, stretching, with a varying width of one to three hundred miles, over twenty-five degrees of latitude, so that Columbus spent three hopeless, endless weeks, in passing through this strange land of ocean-prairies!

Take these fuci out of their briny element, and they

present you with forms as whimsical as luxuriant. They are, in truth, nothing more than shapeless masses of jelly, covered with a leathery surface, and mostly dividing into irregular branches, which occasionally end in scanty bunches of real leaves. The first stem is thin and dry; it dies soon, but the plant continues to grow, apparently without limit. A few are eatable. Off Ireland grows the Carraghen-moss, with gracefully shaped and curled leaves, which physicians prescribe for pectoral diseases. Another kind of sea-fucus furnishes the swallows of the Indian Sea with the material for their world-famous edible nests. The sugar-fucus of the Northern Sea is broad as the hand, thin as a line, but miles long; well prepared, it gives the so-called Marma-sugar.

The Antarctic is the home of the most gigantic of all plants of this kind. The bladder-fucus grows to a length of a thousand feet in the very waters that are constantly congealing, and its long variegated foliage shines in bright crimson, or brilliant purple. The middle ribs of its magnificent leaves are supported underneath by huge bladders, which enable them to swim on the surface of the ocean. Off the Falkland Islands a fucus is found which resembles an apple-tree; it has an upright trunk, with forked branches, grass-like leaves, and an abundance of fruit. The roots and stem cling by means of clasping fibres to rocks above high-water mark, from them branches shoot upwards, and its long pendent leaves hang, like the willow's, dreamy and wo-begone, in the restless waters.

Besides the countless varieties of fucus, the bottom of the sea is overgrown with the curled, deep purple leaves

of the sea-lettuce, with large, porous lichens, and many-branched, hollow algæ, full of life and motion in their rosy little bladders, thickly set with ever-moving, tiny arms.

These plants form sub-marine forests, growing one into another, in apparently lawless order, here interlacing their branches, there forming bowers and long avenues; at one time thriving abundantly until the thicket seems impenetrable, then again leaving large openings between wold and wold, where smaller plants form a beautiful pink turf. There a thousand hues and tinges shine and glitter in each changing light. In the exuberance of their luxuriant growth, the fuci especially seem to gratify every whim and freak. Creeping close to the ground, or sending long-stretched arms, crowned with waving plumes, up to the blessed light of heaven, they form pale green sea groves, where there is neither moon nor star, or rise up nearer to the surface, to be transcendently rich and gorgeous in brightest green, gold, and purple. And, through this dream-like scene, playing in all the colors of the rainbow, and deep under the hollow, briny ocean, there sail and chase each other merrily, gaily painted mollusks, and bright shining fishes. Snails of every shape creep slowly along the stems, whilst huge, gray-haired seals hang with their enormous tusks on large, tall trees. There is the gigantic Dugong, the siren of the ancients, the sidelong shark with his leaden eyes, the thick-haired sea-leopard, and the sluggish turtle. Look how these strange, ill-shapen forms, which ever keep their dreamless sleep far down in the gloomy deep, stir themselves from time to time! See, how they drive each other from their rich pastures, how

they seem to awaken in storms, rising like islands from beneath, and snorting through the angry spray! Perhaps they graze peacefully in the unbroken cool of the ocean's deep bed, when lo! a hungry shark comes slily, silently around that grove; its glassy eyes shine ghost-like with a yellow sheen, and seek their prey. The sea-dog first becomes aware of his dreaded enemy, and seeks refuge in the thickest recesses of the fucus forest. In an instant the whole scene changes. The oyster closes its shell with a clap, and throws itself into the deep below; the turtle conceals head and feet under her impenetrable armor, and sinks slowly downward; the playful little fish disappear among the branches of the macrocystis; lobsters hide under the thick, clumsily-shapen roots, and the young walrus alone turns boldly round and faces the intruder with his sharp, pointed teeth. The shark seeks to gain his unprotected side. The battle commences; both seek the forest; their fins become entangled in the closely interwoven branches; at last the more agile shark succeeds in wounding his adversary's side. Despairing of life, the bleeding walrus tries to conceal his last agony in the woods, but, blinded by pain and blood, he fastens himself among the branches, and soon falls an easy prey to the shark, who greedily devours him.

A few miles further, and the scene changes. Here lies a large, undisturbed oyster bed, so felicitously styled, a concentration of quiet happiness. Dormant though the soft, glutinous creatures seem to be, in their impenetrable shells, each individual is leading the beautiful existence of the epicurean god. The world without, its cares and

joys, its storms and calms, its passions, good and evil—all are indifferent to the unheeding oyster. Its whole soul is concentrated in itself; its body is throbbing with life and enjoyment. The mighty ocean is subservient to its pleasures. Invisible to human eye, a thousand vibrating cilia move incessantly around every fibre of each fringing leaflet. To these the rolling waves waft fresh and choice food, and the flood of the current feeds the oyster, without requiring an effort. Each atom of water that comes in contact with its delicate gills, gives out its imprisoned air, to freshen and invigorate the creature's pellucid blood.

Here, in the lonely, weary sea, so restless and uneasy, we find, moreover, that strangest of all productions, half vegetable and half animal, the coral. From the tree-shaped limestone, springs forth the sense-endowed arm of the polypus; it grows, it feeds, it produces others, and then is turned again into stone, burying itself in its own rocky home, over which new generations build at once new rocky homes.

Thus grows the many-shaped, far-branched coral-tree; but where the plants of the upper world bear leaves and flowers, there germinates here, from out of the stone, a living, sensitive animal, clad in the gay form and bright colors of flowers, and adorned with phosphorescent brilliancy. As if in a dream the animal polypus awakens in the stone for a moment, and like a dream it crystallizes again into stone. Yet, what no tree on earth, in all its vigor and beauty, ever could do, that is accomplished by these strange animal trees. They build large, powerful castles, and high, lofty steeples, resting upon the very

bottom of the ocean, rising stone upon stone, and cemented like no other building on this globe.

For they are a strange mysterious race, these "maidens of the ocean," as the old Greeks used to call them. Their beauty of form and color, their marvellous economy, their gigantic edifices, all had early attracted the attention of the curious, and given rise to fantastic fables, and amusing errors. For centuries the world believed that these bright-colored, delicate flowers, which, out of their element, appeared only humble, brown stones, were real, fragile sea-plants, which the contact with air instantaneously turned into stone. Even the last century adhered yet to this belief, and only repeated and energetic efforts succeeded in establishing their claim to a place in the animal kingdom. Charles Darwin, at last, in the charming account he has given us of his voyages, set all errors aside, and made us familiar with this most wondrous of all creatures.

Now we all know their atolls and coral-rings, in the warm seas of the tropics, with the green crowns of slender palm-trees waving over them in the breeze, and man living securely in their midst. For in vain has he himself tried to protect his lands against the fury of the ocean, in vain has he labored and pressed all the forces of nature, even all-powerful steam, into his service. But the minute polypi work quietly and silently, with modest industry, in their never-ceasing struggle with the mighty waves of the sea. A struggle it is, for, strangely enough, they never build in turbid, never in still waters; their home is amid the most violent breakers, and living force, though so minute, triumphs victoriously over the

blind, terrible might of furious waves. Thus they build, year after year, century after century, until at last their atolls inclose vast lakes in the midst of the ocean, where eternal peace reigns, undisturbed by the stormy waves and the raging tempest. But when their marvellous structure reaches the surface, it rises no further, for the polypi are true children of the deep, and as soon as sun and air touch them they die.

Like enchanted islands, these circular reefs of the corals bask in the brightest light of the tropics. A light green ring incloses a quiet inland lake, the ground is white, and being shallow, shines brilliantly in the gorgeous floods of light, whilst without the dark, black billows of the ocean approach in a line of breakers, rushing incessantly in white foam against the cliffs; above them an ever pure, deep blue ether; and far beyond, the dark ocean and the hazy air blending at the horizon and melting harmoniously into one another. The effect is peculiarly grand and almost magical, when the coral rings are under water, and the huge, furious breakers toss up their white crests in vast circles around the still, calm waters within, whilst no land, no rock is seen to rise above the surface of the ocean.

Frequently large reefs, richly studded with graceful palms, surround on all sides lofty mountains, around whose foot there grows a luxuriant, tropical vegetation. Inside of these reefs the water is smooth and mirror-like, basking in the warm sunlight; without, there is eternal warfare; raging, foaming surges swell and rush in fierce attack against the firm wall, besieging it year after year, century after century. Thus, the tiny polypi protect proud man

on his threatened island against the destructive flood: polypi struggling boldly against the unmeasured ocean! If all the nations on earth united, they could not build the smallest of these coral reefs in the ocean—but the corals build a part of the crust of the great earth! For their islands count alone in the South Sea by thousands; all but a few feet above the surface of the sea, which, around, is unfathomable; all ring-shaped, with a peaceful lake in the centre; all consisting of no other material but that of still living corals. These islands are planted and peopled by the same waves, by whom they were raised above high-water mark. The currents bring seed and carry large living trees from distant shores; lizards dwelling in their roots, birds nestling in their branches, and insects innumerable arrive with the tree, and water birds soon give life to the scanty, little strip of newly made land.

Thus they meet below, plant and animal; the pale, hueless fucus twining its long, ghastly arms around the bright scarlet coral, and through their branches glides the nautilus with wide-spread sails. Every ray of light that falls on the surface, changes hue and tinge below. But the deep has lights of its own. There is the glimmer of gorgeous fish in gold and silver armor, the phosphorescent sheen of the milk-white or sky-blue bells of brilliant medusæ, as they pass through the purple-colored tops of lofty fuci, and the bright, sparkling light of tiny, gelatinous creatures, chasing each other along the blue and olive-green hedges of algæ and humbler plants. When day fades, and night covers with her dark mantle the sea also,

these fantastic gardens begin to shine in new, mysterious light; green, yellow, and red flames are seen to kindle and to fade away; bright stars twinkle in every direction, even the darkest recesses blaze up now and then, in bright flashes of light, and fitful rays pass incessantly to and fro in the wild, dark world beneath the waves. Broad furrows of flashing light mark the track of the dolphins through the midst of the foaming waters. Troops of porpoises are sporting about, and as they cut through the glistening flood, you see their mazy path bright with intense and sparkling light. There also passes the huge moonfish, shedding a pale spectral light from every fin and scale, through the crowd of brilliant starfish, whilst afar from the coast of Ceylon are heard the soft, melancholy accents of the singing mussel, like the distant notes of an Æolian harp, and yet louder than even the breakers on the rocky shore. But the great sea itself is not silent. Listen, and you will hear how the gray old ocean, heaving in a gentle motion, sings in an undertone, chiming in with the great melody, until all the sweet sounds of sea, earth, and air melt into one low voice alone, that murmurs over the weary sea and, low or high, ever sings eternal praise to the throne of Him, who "is mightier than the noise of many waters, yea, than the mighty waves of the sea."

The great botanist, Schleiden, tells us how, off the coast of the island of Sitka, the bottom of the sea is covered with dense and ancient forests, where plant grows close to plant, and branch intertwines with branch. Below, there lies a closely woven carpet of rich hues, made of countless threads of tiny waterplants, red confervæ, and brown-

rooted mosses, each branching off into a thousand finely traced leaves. On this soft couch the luxuriant sea-lettuce spreads its broad, elegant leaves, a rich pasture for peaceful snails, and sluggish turtles. Between them shine the gigantic leaves of the irides in brilliant scarlet or delicate pink, whilst along reef and cliff the dark olive-green fuci hang in rich festoons, and half cover the magnificent sea-rose in its unsurpassed beauty. Like tall trees the laminaria spread about, waving in endless broad ribbons along the currents, and rising high above the dense crowd. Alaria send up their long naked stems, which at last expand into a huge, unsightly leaf of more than fifty feet in length. But the sea-forest boasts of still loftier trees, for the nereocysti rise to a height of seventy feet; beginning with a coral-shaped root, they grow up in a thin, thread-like trunk, which gradually thickens, until its club-shaped form grows into an enormous bladder, from the top of which, like a crest on a gigantic helmet, there waves proudly a large bunch of delicate but immense leaves. These are the palms of the ocean, and these forests grow, as by magic, in a few months, cover the bottom of the sea with a most luxuriant growth, and then wither and vanish, only to reappear soon again in greater richness and splendor. And what crowds of strange, ill-shapen, and unheard of mollusks, fish, and shellfish move among them! Here they are huge balls, there many cornered or starlike, then again long streaming ribbons. Some are armed with large, prominent teeth, others with sharp saws, whilst a few, when pursued, make themselves invisible by emitting a dark vapor-like fluid. Here, glassy, colorless

eyes stare at you with dull, imbecile light—there, deep blue or black eyes glare with almost human sense and unmistakable cunning. Through bush and through thicket there glide the hosts of fierce, gluttonous robbers who fill the vast deep. But not only the animals of the ocean pasture and hunt there; man also stretches out his covetous hand and demands his share.

Proud ships with swelling sails disdain not to arrest their bird-like flight, to carry off vast fucus forests which they have torn up from the bottom of the sea, in order to manufacture kelp or iodine from the ashes, or to fish at the peril of their lives for bright corals in the depth. In the streets of Edinburgh the cry of "buy pepper-dulse and tangle" is heard in our day, and the Irish fisherman boldly faces death to snatch a load of Carraghen-moss from the rapid current. The poor peasant of Normandy gathers the vast heaps of decaying fuci, which wind and wave have driven to his shore, in order to carry them painfully, miles and miles, as manure to his fields, and the so-called sheep-fucus supports the flocks and herds of cattle in many a northern island in Scotland and in Norway, through their long, dreary winters. The men of Iceland and of Greenland diligently grind some farinaceous kind of fucus into flour, and subsist, with their cattle, upon this strange food for many months, whilst their wives follow Paris fashion, and rouge themselves with the red flower of the purple fucus.

Here, however, one of the great mysteries which the ocean suggests, often startles the thinking observer. For whom did the Almighty create all this wealth of beauty

and splendor? Why did He conceal the greatest wonders, the most marvellous creations of nature under that azure veil, the mirror-like surface of which reflects nearly every ray of light, and mostly returns, as if in derision, the searcher's own face as his only reward?

But because all the varied forms, all the minute details are not seen, is therefore the impression, which the ocean produces on our mind, less striking or less permanent? We count not the stars in heaven, we see even but a small number of all, and yet the starry sky has never failed to lift up the mind of man to his Maker. So with the ocean. His way is in the sea, and His path in the great waters. The voice of the Lord is upon the waters; the Lord is upon many waters. From olden times the ocean has ever been to the nations of the earth the type of all that is great, powerful, infinite. All the fictions of the Orient and Eastern India, all the myths of Greece of the "earth-embracing Okeanus," and even the Jewish tradition that "the earth was without form and void, and the spirit of God moved upon the face of the waters," speak of the sea as the great source of all life, the very dwelling-place of the Infinite.

There are nations who never see the ocean. How dream-like, how fantastic are their ideas of the unknown world! German poetry abounds with wild, fanciful dreams of mermaids and mermen, and even the sailor-nation has its favorite legends of the Ancient Mariner, and a Tennyson has sung of fabled mermen and their loves. But truly has it been said that "they that go down to the sea in ships,

that do business in great waters, these see the works of Jehovah and his wonders in the deep."

Uniform and monotonous as the wide ocean often appears, it has its changes, and is now mournful, now cheery and bright. Only when the wind is lulled and a calm has soothed the angry waves, can the ocean be seen in its quiet majesty. But the aspect is apt to be dreary and lonely; whether we see the dark waves of the sea draw lazily in and out of rocky riffs, or watch wearily "the sea's perpetual swing, the melancholy wash of endless waves." Away from the land there is nothing so full of awe and horror as a perfectly calm sea: man is spell-bound, a magic charm seems to chain him to the glassy and transparent waters; he cannot move from the fatal spot, and death, slow, fearful, certain death, stares him in the face. He trembles as his despairing gaze meets the upturned, leaden eye of the shark, patiently waiting for him, or as he hears, far below, the sigh of some grim monster, slowly shifting on his uneasy pillow of brine. Fancy knows but one picture more dreadful yet than tempest, shipwreck, or the burning of a vessel out at sea: it is a ship on the great ocean in a calm, with no hope for a breeze. Wild and waste is the view. On the same sunshine, on the same waves the poor mariners gaze day by day with languid eye, even until the heart is sick and the body perishes.

At other times it is the gladsome ocean, full of proud ships, of merry waves, and ceaseless motion, that greet the eye. Then the wild, shoreless sea, on which the waves have rolled for thousands of years in unbroken might,

fills the mind with the idea of infinity, and thought, escaping from all visible impression of space and time, rises to sublimest contemplations. Yet, the sight of the clear, transparent mirror of the ocean, with its light, curling, sportive waves, cheers the heart like that of a friend, and reminds us that here, as upon the great sea of life, even when the wrecked mariner has been cast among the raging billows, an unseen hand has often guided him to a happy shore. For He ruleth the raging of the sea: when the waves thereof rise, He stilleth them.

This sense of the Infinite, suggested and awakened by the vast expanse of restless and uneasy waters is, however, not unmixed with a feeling of deep mysterious awe. The mind cannot seize nor comprehend this boundless grandeur; hence its mysteriousness. The eye cannot see, no sense can, in fact, perceive the connection between the stupendous phenomena on the wide ocean and the fate of man. To human eyes the surging billows and the towering waves are both raised by an invisible, unknown power, and their depth is peopled with beings uncouth, ungoverned, and unknown. The sea is lonely, the sea is dreary, like a wide, watery waste, compared with the gay, bright colors of the land, and the might of gigantic waves that rush from age to age against the bulwarks of continent and isle, seems irresistible and able to destroy the world's foundation. Thus the ocean awakens in us feelings of dark mystery and grim power; the Infinite carries us off beyond the limits of familiar thought, and the sea becomes the home of fabled beings and weird images. All sea-shore countries teem with such stories, legends and traditions;

the fickle sea, the envious ocean, the fierce, hungry waves, the furious breakers, all become the representatives of so many human passions. Our fancy peoples the ocean with sweet, luring sirens, endowed with magic power to weave a spell and to draw the yielding mariner down to the green crystal halls beneath the waves. There sea-kings and morgana fairies live in enchanted palaces; monsters of unheard size and shape flit ghost-like through that dark, mysterious realm, and huge snakes trail themselves slowly from "their coiled sleep in the central deep, amidst all the dry pied things that lie in the hueless mosses under the sea." The bewildered and astounded mind tries, in his own way, to connect the great phenomena of nature with his fate and the will of the Almighty. It sees in homeless, restless birds the harbingers of the coming storm, in flying fishes the spirits of wrecked seamen, and points to the Flying Dutchman and the Ancient Mariner as illustrations of the justice of God's wrath.

The strong mind, the believing soul, of course, shake off all such idle dreams and vain superstitions. To them the sea is the very source of energy and courage. The life at sea is a life of unceasing strife and struggle. Hence all sea-faring nations are warlike, fond of adventures, and poetical. But the sea's greatest charm is, after all, its freedom. The free, unbounded ocean, where man feels no restraint, sees no narrow limits, where he must rely upon his own stout heart, strong in faith, where he is alone with his great Father in heaven, gives him a sense of his own freedom and strength, like no other part of the earth, and makes him return to the sea, its perils and

sufferings, in spite of all the peace and happiness that the land can afford him. He knows that even if he dwell in the uttermost parts of the sea, even there shall His hand lead him and His right hand shall hold him.

IV.

A Chat about Plants.

"If we could open and unbind our eyes,
We all, like Moses, should espy,
E'en in a bush, the radiant Deity.
But we despise these, his inferior ways,
(Tho' no less full of miracle and praise):
Upon the flowers of heaven we gaze;
The stars of earth no wonder in us raise,
Tho' these perhaps do, more than they,
The life of mankind sway."—COWLEY.

LONG years ago I was in the Holy Land. It was the last day I was to spend near Jerusalem, and as the sun sank towards the blue waters of the Mediterranean, I found myself once more sitting on the banks of the Jordan. The air was perfectly calm; the tolling of a convent bell came faintly over the plain from Bethlehem, and mingled its well-beat cadences with the gentle, playful murmuring of the sacred stream at my feet. By my side sat an Arab, tranquilly following with his eye the light clouds of his pipe, as they gracefully rose up in the clear, blue ether, but apparently buried in deep thought. I had known

him in his desert home, I had eaten his salt. He was a Sheikh, and revered as a saint among his brethren. He had now come with me from the far south, first my guide, but now my friend and companion. Abu Abdallah was his name; so I said, "Abu Abdallah, do you believe in God?" "Thou sayest it, oh brother!" was his quiet answer. "But Abu Abdallah, I fear you do not believe that your soul is immortal;" for the old Arab, though my friend for the while, was a sad thief, and when he swiftly rode through the desert, there were voices heard, it was said, mournful voices of men, who called for the sweet life he had taken from them. He gazed at me for an instant from the depth of that unfathomable eye, the precious heirloom of a son of the Orient, but vouchsafed not a word. I was struck by his silence, and asked again. "Oh brother, oh brother, thou wrongest me!" he said, and quietly rising, he seized upon a little shapeless mass, that lay half hid in the fragrant herbs at our feet, and gently pushing it into the purling stream, he added: "Has not the God of our fathers, whose prophet is Mahomet, given us the Rose of Jericho? And does not my brother, who reads the books of the wise men of the Franks, know that the burning sands of the desert are its home, and that it delights in the fiery winds of the west, which scatter the caravan, and strew the sands of the Sahara with the bones of the traveller? There it grows and blossoms, and our children love it. But the season comes again, and it withers and dies. And the dread simoom rises, and seizes the dry, shrivelled roots, that my brother beholds there, and on the wings of the tempest the Rose of Jericho rides

far far east, until it falls upon holy soil. Now let my brother wait and he shall see!"

And we did wait, waited until the shadows grew long, and dreamy dusk covered mountain and plain. And the little shapeless mass became a miracle indeed, and right before our eyes! The roots had expanded, the leaves had unfolded, life and breath had returned to the dead child of the Sahara, and the very blossoms began to show, and to rival the faint rosy tints of the evening sun!

I never forgot that lesson of immortality—I never forgot that Rose of Jericho. On my return to Europe I learned that botanists called it "Anastatica," the flower of resurrection. I wished to know more about it, and that was the way I first learned something about plants.

I found botany very little attractive—very little deserving of its ancient name of the "lovely science." I found that botanists would go out into the fields, their text-books in their pockets, and gather the tender children of Flora into huge maps, then dry them and classify them, describe their head-dress and uniform, their rank and dignity, and finally deposit them in magnificent herbariums. There they were, well dried and well pasted, clad, to be sure, in all the pomp and circumstance of high-sounding names—so much Latin hay. But where was their color and graceful shape? where the breath of air that made them gently wave to and fro? where the sweet perfumes they gratefully sent up to their Maker? where the bright water at their side, in which they reflected their lovely form? where the whole glorious scene for which they were

intended by Nature, and to which they lent, in return, life and beauty?

Botanists of old collected the material only—not without bestowing unceasing industry upon it, not without making unheard of sacrifices, often of the very lives of devoted laborers in that field of science—but they were content with a form only and a name. They were like the French officer who, in one of the French revolutions, came to Rome, and there had the good fortune to discover a highly important inscription on a monument, dating far back into antiquity. Proudly, and carefully, he detached one bronze letter after another, then slipped them, all loosely, into a bag, and sent them to the antiquarians of Paris to be deciphered.

But there have arisen, within the last thirty years especially, men who have studied plants with the view, not only to know who they were, but rather what they were, how they lived and how they died, what their relation was to the world, and what their purpose in the great household of Nature. Kindred sciences have lent their aid; the microscope has laid open the innermost recesses of plants; travellers have brought home new, comprehensive views, and an insight has at last been gained into the life of the world of plants. Great, startling discoveries have there been made, new truths and new beauties have been revealed to us, and natural science has unfolded the most delicate resources and most curious relations in the vegetable kingdom.

Thus we have learned, that it is a fallacy—to be sure as old as botany itself—that plants have no motion. Aris-

totle, it is true, had a curious idea, that they were buried in deep slumber, out of which nothing could awake them, and that thus, by a kind of enchantment, they were spell-bound, until the great word should be spoken, that was to restore them to life and motion. Modern science also teaches that the characteristic of organic bodies is independent motion, that of inorganic, rest. But plants have both life and motion; we dare not, as yet, say whether it be the effect of a mere dream, of a mechanical pressure from without, or of instinctive life within. For what do we as yet know of the simplest functions of the inner life of plants? Who has not, however, observed how the pale sap courses now through the colossal stems of gigantic trees, and now through the delicate veins of a frail leaf, as rapidly and marvellously as through the body of a man? Take a microscope and you will see the plant full of life and motion. All its minute cells are filled with countless little currents, now rotary and now up and down, often even apparently lawless, but always distinctly marked by tiny grains which are seen to turn in them or to rise without ceasing. In this world nothing is motionless, says a modern philosopher. Let the air be so still, that not a breath shall be felt to creep through it, and yet the forest leaves will seem stirred as if in silent prayer. The earth moves small things and great, all obey the same law, and the little blade of grass goes around the sun as swiftly as the tallest pine. The very shadow dances, as if in idle mockery, around the immovable flower, and marks the passing hours of sunshine.

But plants move not only where they stand—they travel

also. They migrate from land to land, sometimes slowly, inch by inch, then again on the wings of the storm. Botanists tell us of actual migrations of plants, and a successive extension of the domain of particular floras, just as we speak of the migration of idioms and races. Individual plants, however, travel only as man ought to travel, when they are young. If they have once found a home, they settle quietly down, grow, blossom, and bear fruit. Therefore it is, that plants travel only in the seed. For this purpose, seeds possess often special organs for a long journey through the air. Sometimes they are put, like small bombshells, into little mortars, and fired off with great precision. Thus arise the well-known emerald rings on our greensward, and on the vast prairies of the West, which some ascribe to electricity, whilst the poet loves to see in them traces of the moonlight revels of fairies. The truth is scarcely less poetical. A small circular fungus squats down on a nice bit of turf. It prospers and fills with ripening seed. When it matures, it discharges its tiny balls in a circle all around, and then sinks quietly in the ground and dies. Another season, and its place is marked by an abundance of luxuriant grass, feeding upon its remains, whilst around it a whole ring of young fungi have begun to flourish. They die in their turn, and so the circle goes on enlarging and enlarging, shifting rapidly because fungi exhaust the soil soon of all matter necessary for their growth, and closely followed by the rich grass, that fills up their place, and prevents them from ever retracing their steps.

A similar irritability enables other plants to scatter

their seeds far and near, by means of springs bent back, until a breath of wind, a falling leaf, or the wing of an insect, causes them to rebound, and thus to send the pollen with which they are loaded often to a great distance. The so-called Touch-me-not balsam scatters its ripe seeds, by such a contrivance, in all directions, and the squirting cucumber is furnished, for the same purpose, with a complete fire-engine. Some of the geraniums, also, of our greenhouses have their fruit-vessels so curiously constructed, that the mere contact with another object, and frequently the heat of the sun alone, suffice to detach the carpels, one by one, with a snapping sound, and so suddenly as to cause a considerable jerk, which sends the seeds far away.

Other fruit-vessels again have, as is well known, contrivances the most curious and ingenious, by which they press every living thing that comes near them into their service, and make it convey them whithersoever they please. Every body is familiar with the bearded varieties of wheat and other grain; they are provided with little hooks, which they cunningly insert into the wool or hair of grazing cattle, and thus they are carried about until they find a pleasant place for their future home. Some who do not like to obtain services thus by hook and crook, succeed by pretended friendship, sticking closely to their self-chosen companions. They cover their little seeds with a most adhesive glue, and when the busy bee comes to gather honey from their sweet blossoms, which they jauntily hang out to catch the unwary insect, the seeds adhere to its body, and travel thus on four fine wings through the wide, wide world. Bee fanciers know very

well the common disease of their sweet friends, when so much pollen adheres to their head that they cannot fly, and must miserably perish, one by one, under the heavy burden which these innocent-looking plants have compelled them to carry. We have but little knowledge as yet of the activity of life in the vegetable world, and of its momentous influence on the welfare of our own race. Few only know that the gall-fly of Asia Minor decides on the existence of ten thousands of human beings. As our clippers and steamers carry the produce of the land from continent to continent, so these tiny sailors of the air perform, under the direction of Divine Providence, the important duty of carrying pollen, or fertilizing dust, from fig-tree to fig-tree. Without pollen there can be no figs, and, consequently, on their activity and number depends the productiveness of these trees; they, therefore, regulate in fact the extensive and profitable fig trade of Smyrna. A little, ugly beetle of Kamschatka has, in like manner, more than once saved the entire population of the most barren part of Greenland from apparently certain starvation. He is a great thief in his way, and a most fastidious gourmand, moreover. Nothing will satisfy him on a long winter evening—and we must charitably bear in mind that these evenings sometimes last five months without interruption—but a constant supply of lily bulbs. The lilies are well content with this arrangement, for the being eaten is as natural to them as to a Feejee-islander; and they are, as compensation, saved from being crowded to death in a narrow space, whilst those that escape the little glutton, shoot up merrily, next summer, in rich pastures. Still

better content are the Greenlanders; for, when their last mouthful of meat, and their last drop of train-oil are gone, they dig and rob the little, provident beetle of his carefully hoarded treasure, and, by its aid, manage to live until another season. It is thus that we see every where the beautiful and close bonds of love connecting even those parts of creation which seem to be without sense or voluntary motion, humble subjects of their masters, the elements, and which yet respond to the action of those mysterious powers, that rule, under God, in nature. The flower opens its gorgeous chalice, filled with rich honey, to the tiny insect; the insect, in return, carries the fructifying pollen to the flower's distant mate, and thus propagates it anew. The herbs of the field send forth their luxuriant tufts of leaves for the browsing cattle, and sheep and oxen carry the seed in their hides from meadow to meadow. The trees themselves, planted by stones that birds have dropped, grow and flourish until "they are strong, and the height thereof reaches unto heaven, and the beasts of the field have shadow under it, and the fowls of heaven dwell in the boughs thereof."

When neither quadruped nor insect can be coaxed or forced to transport the young seeds that wish to see the world, they sometimes launch forth on their own account, and trust to a gentle breeze or a light current of air, rising from the heated surface of the earth. It is true, nature has given them wings to fly with, such as man never yet was skilful enough to devise for his own use. The maple—our maple, I mean—has genuine little wings, with which it flies merrily about in its early days; others,

like the dandelion and the anemone, have light downy appendages, or little feathery tufts and crowns, by which they are floated along on the lightest breath of air, and enjoy, to their heart's content, long autumnal wanderings. These airy appendages are marvellously well adapted for the special purpose of each plant: some but just large enough to waft the tiny grain up the height of a molehill, others strong enough to carry the seed of the cedar from the low valley to the summit of Mount Lebanon. The proudest princes of the vegetable kingdom often depend for their continuance on these little feathery tufts, which but few observers are apt to notice. A recent writer tells us that, some years ago, the only palm-tree the city of Paris could then boast of, suddenly blossomed. Botanists were at a loss how to explain the apparent miracle, and sceptics began to sneer, and declared that the laws of nature had failed. An advertisement appeared in the papers, inquiring for the unknown mate of the solitary tree. And behold, in an obscure court-yard away off, there had lived, unknown and unnoticed, another small palm; it also had blossomed apparently alone and in vain—but a gentle breeze had come, and carried its flower-dust to its distant companion, and the first palm-flowers ever seen in France were the result of this unseen mediation.

Reckless wanderers, also, there are among the plants, who waste their substance, and wildly rove about in the world. The rose of Jericho, which we have already noticed, and a club-moss of Peru, are such erratic idlers that wander from land to land. When they have blossomed and borne fruit, and when the dry season comes, they

wither, fold their leaves together, and draw up their roots, so as to form a light, little ball. In this form they are driven hither and thither on the wings of the wind, rolling along the plains in spirit-like dance, now whirling in great circles about, now caught by an eddy and rising suddenly high into the air. It is not until they reach a moist place that they care to rest a while, but then they settle down at once, send down their roots, unfold their leaves, assume a bright green, and become quiet, useful citizens in their own great kingdom of plants.

There are, however, thousands of plants having neither servants nor wings to gratify their wishes, who seem condemned to see their offspring die at their feet. But here again we see how the resources of nature are always far superior to the apparent difficulty. These very seeds which seemed so hopelessly lost, often travel fastest of all; they travel on the wings of birds. The latter steal our fruit, our cherries and grapes; they carry them off to some convenient place, eat the pulpy part, and drop the stone or the seed where it is most likely to find a genial soil and a sheltered home. Even their evil propensities must thus serve the purposes of nature. Jays and pies, it is well known, are fond of hiding grains and acorns among grass or moss and in the ground, and then, poor things, forget the hiding place, and lose all their treasure. Squirrels, also, marmots and mice bury nuts under ground, and often so deep that neither light nor warmth can reach the hidden store. But then comes man, and cuts down the pine-wood, and lo! to the astonishment of all, a young coppice of oaks shoots up, and the wonder is, where all the acorns

have so suddenly come from. It is not without its ludicrous side, to see even the ingenuity of men baffled by these unconscious but faithful servants of nature. We are told that the Dutch, with a kind of sublime political wisdom, destroy the plants that produce our nutmeg, for the purpose of keeping up their monopoly, and high prices into the bargain, by the limited amount of the annual produce, which is entirely in their hands. With this view, they used to cut down every tree of the kind in the Molucca Islands, where it was originally indigenous, and to punish, with the severest penalties, the mere possession of a nut. But it so happens that a little bird of the same Moluccas, also, is fond of these nuts; and as the air cannot very well be guarded and watched, even by Dutch ingenuity, he insists upon eating them, and carries the seed to distant islands of the ocean, causing the unfortunate Hollanders infinite trouble and annoyance.

Seeds that have not learned to fly with their own or other people's wings are taught to swim. Trees and bushes which bear nuts, love low grounds and the banks of rivers. Why? Because their fruit is shaped like a small boat, and the rivulet playing with its tiny ripples over silvery sands, as well as the broad wave of the Pacific, carry their seed alike, safely and swiftly, to new homes. Rivers float down the fruits of mountain regions, into deep valleys and to far off coasts, and the Gulf Stream of our own Atlantic carries annually some of the rich products of the torrid zone of America to the distant shores of Iceland and Norway. Seeds of plants growing in Jamaica and Cuba have been gathered in the quiet coves

of the Hebrides. The gigantic cocoa-nut itself, weighing not rarely more than five pounds, but air-tight in its close shell, and buoyant by its light fibrous coat, is thus drifted from island to island, and rides safely on the surges of the ocean from the Seychelles to the distant coast of Malabar. There it lodges, and germinates in the light moist sand, so that the Indians of old fancied that they grew under water, and called them sea-cocoas. A still more striking provision of nature is this, that there are some seeds of this kind so exquisitely adjusted to their future destination, as to sink in salt water, while they swim with safety in sweet water.

Large vegetable masses even travel on the great waters of the ocean. Compact fields of marine plants are occasionally met with in the southern seas, and on the coast of Florida, large enough to impede the progress of vessels, and filled with millions of crustaceæ. They are not unfrequently so firm and so extensive as to afford a building place for the nests of aquatic birds and even for quadrupeds, who thus float at the mercy of wind and waves to their new unknown home. Amid the Philippine Islands, also, after a typhoon, floating islands are fallen in with, consisting of matted plants and wood, with tall, old trees, growing on them. These strange, insular rafts, are carried along by swift currents, or wafted onward by the slightest breath of air which fans the foliage of their dense woods, until, after a passage of weeks or months, they land, like a new ark, on some distant shore. The very plants of our fields, that sustain our life, are there only because man has been compelled to take them with him on his

travels from continent to continent. Wheat has thus left its first home in Asia and travelled westward around the world, whilst maize, and potatoes, have gone in the other direction, from our land to the farthest east. And, unfortunately, man had to take the bad with the good, and, for his sins no doubt, weeds seem to follow him more closely, and to adhere more tenaciously to his home, than all other friends, so that scholars have succeeded in determining the race of early settlers in many a country by studying the weeds that were found in the place of their former habitations.

But we need not go to far-off countries to see plants wandering about in the world: our own gardens afford us, though on a smaller scale, many an instance of the travelling propensities of these very plants that are so much pitied because they cannot move about and choose their own home. Every casual observer even knows that many bulbs, like those of crocus, tulips, or narcissus, rise or sink by forming new bulbs above or below, until they have reached the proper depth of soil which best suits their constitution—or perhaps their fancy. Some orchids have a regular locomotion: the old root dies, the new one forms invariably in one and the same direction, and thus they proceed onwards year after year, though at a very modest, stage-coach rate. Strawberries, on the contrary, put on seven-league boots, and often escape from the rich man's garden to refresh the weary traveller by the wayside. Raspberries, again, mine their way stealthily under ground, by a subterranean, mole-like process; blind, but not unguided, for they are sure to turn up in the

brightest, sunniest spot they could have chosen, had their eyes been wide open, and their proceedings above ground.

As if in return for the manifold services which plants require and receive from their fellow creatures, they show kindness of their own to animal life, and shelter and feed the most timid as well as the noblest of beings, with the hospitality of their generous life. In early childhood already we are taught, that even the smallest of seeds, the mustard seed, grows up to be a tree, "in whose branches the fowls of the heavens have their habitation," that "both Judah and Israel dwelt safely, every man under his vine and under his fig-tree, all the days of Solomon," and that Deborah, the prophetess, "dwelt under a palm-tree." Modern science has furnished us numerous new and striking instances of the great variety of life, which is thus intimately connected with the vegetable kingdom. It is not only that the plaintive nightingale sings in the murmuring poplar, whilst the gay butterfly loves the sweet-scented rose, that the sombre yew hides the owl's nest, and the dark northern pine harbors the fur-clad squirrel. Animals, invisible to the naked eye, have been found to float in the sap of trees, and even the smallest moss has its own tiny insect, which it boards and lodges. Aphides and gall insects live, in every sense of the word, on the leaves of plants, flies and butterflies on their flowers, and ants and worms crowd upon them, after death, in countless multitudes. Every plant, moreover, is inhabited by some insect, to which it affords an exclusive home. Many caterpillars are thus born and die with the leaf on which they live, whilst, on the other hand, the proud

monarch-oak alone supports seventy different kinds of insects—a swarm, which sets all measurement at defiance, and, moreover, replaces by numbers and the enormous voracity which they exhibit, what they want in bodily magnitude.

Already Pliny was surprised to see small ants run up the tall cypress, and devour its rich fruit with surprising avidity; he wondered that so insignificant an insect should be allowed to destroy the seed of the largest tree of his country. But plants have to support guests of every size and shape. The butterfly and its less gaudy relations, drink with their long trunks sweet honey out of gorgeously colored flower-cups; four-winged bees carry away the precious dust of anthers in large spoons, fastened to their thighs; gall insects pierce with sharp daggers the tender leaf, drink its refreshing juice, and deposit their eggs in the delicate texture; beetles gnaw and saw with a hundred curiously shaped instruments through the hardest wood of noble trees, and naked, helpless-looking worms make the very trunk their cover and their home, and with sharp augers often destroy whole forests. The ingenious ant of South America has its winter residence in the warm ground, and its cool summer house on tall plants. For there grows on the banks of the Amazon river a gigantic reed, nearly thirty feet high, which is frequently crowned with a large ball of earth, like the golden globe on the utmost end of a lofty church steeple. This is the comfortable home of myriads of ants, which retire to these safe dwellings, high and dry, at the time of rains and during the period of inundation, rising and descending in

the hollow of the reed, and living on what they find swimming on the surface of the water. Another curious lodger of a South American plant is the famous cochineal bug, well known from the precious red color that bears its name, and which it draws from a certain cactus until its body becomes impregnated with brilliant scarlet. It is probably the most sedentary of all insects, making but one short journey in early life, and then settling down for ever upon one and the same spot. As soon, namely, as the young insect leaves its egg, it manifests great activity and a restless desire to travel. But alas! it finds itself upon a prickly, thorny stem, hanging high in the air, and in contact with no other. But nature soon comes to its aid, and sends a small spider to spin a silken thread from branch to branch. Upon this slender, trembling bridge the young cochineal wanders boldly out to a new world, seeks a promising spot, deliberately sinks its fragile trunk into the juicy leaf—and never draws it back again, drinking, drinking, like a toper as he is, through his whole existence.

Even larger inhabitants are often found on quite small plants. Thus England produces a slight but well supported thistle, which is frequently found to bear little elaborate nests, a few inches above the ground. These contain not insects, but mice, though of the smallest variety known, and are occasionally large enough to hold as many as nine young ones, carefully stowed away and well secured against all enemies and dangers.

Birds seem, of course, the most natural lodgers of plants; they find there abundance of nourishment, all the

material for building their nests, and a well-protected home. The eagle gathers the knotted branches of oaks or pines, to bring up his fierce brood upon the hard, uncushioned couch; the thorn tears a handful of wool from the passing sheep, for its tiny inhabitants, and the despised mullein covers its broad leaves with the softest of downs, to line the bed of the delicate children of the humming bird. There is probably no bush and no tree, that has not its own particular bird; every where do the fowl of the air find a foliage, thicker or thinner, to shelter them against rain, heat and cold; a hollow trunk affords safe and warm lodgings; soft moss carpets their dwellings, and insects and worms swarm around, to offer, at the same time, food in abundance. The birds give, in return, life and sound to the immovable plant. Song birds of many kinds perch and sing their beautiful anthems on every spray; locusts thrill their monotonous and yet pleasing note among a world of leaves through long summer noons, and the katy-did utters its shrill cry during sultry nights. They all love their home, making it their dwelling by night and by day, and many are the instances in which birds, that had long lived in certain trees, have died from true sorrow, when the latter were felled.

Monkeys, also, it is well known, are frugivorous animals, and by their food as well as by the peculiar structure of their body, so closely bound to trees that they but seldom leave them. The tree-frog clings to the rugged trunk, mingling its faded colors with those of the bark, and feasting upon the insects hid in each crevice. The unsightly sloth fastens its enormous claws to the branches,

and passes thus, head downward, with astounding alacrity, from tree to tree; whilst even the black tiger of South America, finding the undergrowth too dense and impenetrable, lives on trees, and in his bloody race, leaps from branch to branch, until he has hunted down his exhausted prey.

Nor has man himself neglected to avail himself of trees, as a dwelling or a home. Already Lucinius Mutianus, an ex-Consul of Lycia, took pleasure in feasting twenty-one guests in a hollow plane-tree; and modern travellers tell us of a gigantic Boabab in Senegambia, the interior of which is used as a public hall for national meetings, whilst its portals are ornamented with rude, quaint sculptures, cut out of the still living wood. The sacred fig-tree of India, which, as Milton says, is seen

> "Branching so broad along, that in the ground
> The bending twigs take root, and daughters grow
> About the mother tree, a pillar's shade
> High overarch'd, with echoing walks between,"

is worshipped as sacred, and the lazy, helpless priest, the Bonze, builds himself a hut, not unlike a bird's cage, in its branches, where he spends his life, dreaming in contemplative indolence, under its cool, pleasant shade. Nay, whole nations live in the branches of trees. There is a race of natives in South America, west of the mouth of the Orinoco, the Guaranis, who have never yet been completely subdued, thanks mainly to their curious habitations. The great Humboldt tells us, that they twine most skilfully the leaf-stalks of the Mauritius palm into cords, and weave them with great care into mats. These they

suspend high in the air from branch to branch, and cover them with clay; here they dwell, and in a dark night the amazed and bewildered traveller may see the fires of their dwellings high in the tops of lofty forests.

More civilized countries even have not left us without similar, though isolated instances of men who have found a dwelling in the trees of the forest. Evelyn tells us of the huge trunk of an oak in Oxfordshire, which served long as a prison for felons; and he who lived in the shades of old Selborne "so lovely and sweet," mentions an elm on Blechington Green, which gave for months reception and shelter to a poor woman, whom the inhospitable people would not receive into their houses. When she reappeared among them, he says, she held a lusty boy in her arms. Men are, however, more frequently buried than born in trees. The natives of the eastern coast of Africa hollow out soft, worm-eaten Boababs, and bury in them those who are suspected of holding communion with evil spirits. Their bodies, thus suspended in the dry chambers of the trunk, soon become perfect mummies. The Indians of Maine had a more touching custom of the kind. They used to turn up a young maple-tree, place the body of a dead chief underneath, and then let the roots spring back, thus erecting a sylvan monument to his memory.

Where there is life, there are plants, and on land and on water, on the loftiest mountain top, and in the very bowels of the earth, every where does man find a plant to minister to his support and enjoyment, every where he sees plants quietly and mysteriously perform their humble duty in the great household of nature. Plants alone—

it would, at first sight, appear—have no home, for they seem to be at home every where. Turn up the soil, where you will, to any depth, and such a rich abundance of vegetable life is mixed with the loam, that almost instantaneously plants innumerable spring up from seeds, which may have lain slumbering for thousands of years in the warm bosom of our mother earth. Man himself cannot master this exuberance of vegetable life. He may change it by cultivation, it is true, but that also only for a time. And what is a generation, or two, in comparison with the eternal earth? Do not, even in our day, and before our eyes, lofty trees raise their proud heads, where our fathers cut the green turf with their sharp plough? In vain does man take the Alpine rose from the banks of its pure mountain brook and plant it in the lowly valley; in vain does he bring costly seeds from the Indies and the warm climes of the tropics, even to the ice-clad coast of Norway. They live and pine and die. In vain does he sometimes seek to reverse nature itself. He places bubbling fountains on the top of high hills, and plants lime-trees and poplars between great masses of rocks; vineyards must adorn his valleys, and meadows spread their soft velvet over mountain sides. But "naturam furca expellas, tamen etsi recurret." A few years' neglect, and how quickly she resumes her sway! Artificial lakes become gloomy marshes, bowers are filled with countless briers, and stately avenues overgrown with reckless profusion. The plants of the soil declare war against the intruders from abroad, and claim once more their birthright to the land of their fathers. The fine well-trimmed turf is smo-

thered under a thousand coarser plants; rank grass and fat clover overspread the exotics; briers climb up with the aid of hooks and ladders, as if they were storming a fortress; nettles fill the urns of statues with their thick tufts, and unsightly mosses creep upon the very faces of marble beauties. Wild cherry-trees and maples seize on every cornice and cleft of the stately mansion; hardy invincible roots penetrate into the slightest opening, until at last victory is declared, and the trees of the forest wave their rich foliage over the high turrets, and raise triumphantly on spire and pinnacle, the gorgeous banner of Nature.

Thus we gain the impression, so encouraging and pleasing to reflecting man, that all nature is everywhere full of life—a life, moreover, varied by a thousand shades and as yet but little known. For there is high life and low life among plants as among men. The stately palm raises its high, unbroken pillar, crowned with sculptured verdure, only in the hot vapors of Brazilian forests and tropical climes, and like a true "king of the grasses," as the ancient Indians called the noble tree, it must fare sumptuously and upon the richest of earth's gifts, before it justifies the prophet's saying, that "the righteous shall flourish like the palm-tree." How humble, by its side, the lowly moss, barely visible to the naked eye, clad in most modest garb, and yet faithfully covering, with its warm mantle, the dreary, weather-beaten boulders of northern granite, or carpeting our damp grottoes, and making them resplendent with its phosphorescent verdure! The brilliant flower of Queen Victoria's namesake, the most superb cradle in

which child was ever rocked, must needs float its rosy leaves on the warm bosom of the silent lakes of Guiana, and the aristolochia of South America, whose flowers are large enough to serve Indian boys as hats or helmets, deigns not to live, unless it can bathe its delicate roots in the shady waters of the Magdalen river. Theirs is the warm golden light of the sun, theirs the richest of soils, the purest of waters, an everlasting summer, an unbroken enjoyment. And yet, are they really more beauteous and graceful than the humble house-leek, which flourishes under circumstances that would be fatal to almost all other plants? In the very driest places, where not a blade of grass, not a spire of moss can grow, on naked rocks, old crumbling walls, or sandy, parched plains, these step-children of nature are seen to thrive and to prosper. Alternately exposed to the heaviest dews at night, and the fiercest rays of the noonday sun, they withstand all, and live upon so small a particle of soil, that it seems to them more a means of keeping them stationary, than a source of nutriment. Rock-roses bear that name, because they will only flourish in dry, rocky places, where other plants would never find a due supply of moisture. These rocks they are industriously engaged in ornamenting with a profusion of brilliantly colored flowers, for nature loves to combine every where the beautiful with the useful. Still, their beauty is but short-lived; their blossoms usually expand at night, and after a few hours' exposure to the sun, they perish. But their long evergreen branches trail, year after year, with great beauty, over the rough banks and rocky cliffs that give them a shelter and a home.

The very sand of the sea, dry and drifting at the mercy of the waves, fickle and false to a proverb, is not too poor for a most useful plant, the so-called sand-reed. It has no beauty of form to please the eye, no delicacy of structure to engage our attention, the cattle themselves will not touch it. But when planted by the hand of man, to give firmness to dykes and embankments, it pierces them with an entangled web of living structure, which offers a resistance stronger than that of the gigantic walls of fabled Cyclops, and is but rarely overcome by the violence of the storm and the fury of the waves. The loose sand of South American deserts still harbors little cacti, so small, and so slightly rooted in their unstable home, that they get between the toes of the Indian—and even the fearful deserts of Africa, those huge seas of sand without a shadow, are at least surrounded by forest shores, clothed in perpetual verdure; even in their midst a few solitary palm-trees, sighing in loneliness for the sweet rivulets of the oasis, are scattered over the awful solitude, and wherever a tiny thread of water passes half concealed through the endless waves of sand, a line of luxuriant green, marks it to the exhausted traveller, and reminds him of the green pasture and still waters of Holy Writ.

Nor are plants dwellers upon land only: the waters also teem with vegetable life, and the bed of the mighty ocean is planted with immense submarine forests and a thousand varied herbs, from the gigantic fucus, which grows to the length of many hundred feet, and far exceeds the height of the tallest tree known, to the little yellow blossom

of the duck-weed on our ponds. Every river has its own reed; some, covered with snow for a part of the year, hardly rise above the sluggish, silent waters of the Irtis in cold Siberia; others form ever-murmuring forests of graceful bamboo on the banks of the Ganges. For the earth opposes every where to the encroaching tides of the ocean, another sea of restless vegetation, yielding constantly, and yet never giving way, with its green waves, so delicate, fragile, and airy, and yet as strong in their very weakness as the deep-blue waves of the ocean. Further out at sea, enormous sponges fill vast spaces of the watery realm, and, when mature, break loose from their safe anchorage, to float in countless myriads through the surrounding sea. For here, also, nature pours out, with a lavish hand, living food, storing even the waves with nutriment for their gigantic denizens, and literally casting bread upon the waters for the animate world of the ocean. In other zones, immense and permanent banks of verdure are met with, by far exceeding the largest prairies on land, true oceanic meadows. For twenty-three long days did Columbus sail through one of these marvels of western waters, covering an area like that of all France; and yet there it is, even now, as large and as luxuriant as it was more than three centuries ago.

Truly, man is not alone a cosmopolite. Plants precede him as they follow his footsteps, wherever restless ambition may lead him: Their domain is the whole earth. They are not driven away by the cold of the Arctic; they endure the fiery heat of the volcano.

Trees and shrubs gather around the desolate North Cape

in spite of eternal winter, and relentless storms. Ice-clad Spitzbergen even boasts still of a willow, the giant of these Arctic forests, the woody stems of which, it is true, creep so close to the ground, and conceal themselves so anxiously in the turf bogs, that the small leaves, never rising more than an inch or two, are hardly discoverable amid the thick moss. The plains bordering on the Icy Sea are full of cryptogamous plants, and show even, here and there, patches of green turf, a most gladsome sight to the weary traveller. The swampy districts, also, which there extend further than eye can reach, are covered with a closely woven carpet of mosses, minute in size, and yet so abundant, that they support immense herds of reindeer for a whole, dreary season. Even the perpetual snow of the polar regions is often adorned with beautiful forests of diminutive plants, and extensive fields of bright scarlet are seen, consisting of myriads of minute fungi and microscopic mushrooms, which form the so-called "gory dew," beheld by early navigators with a wonder nearly akin to awe. Captain Richardson found the ground near the Arctic circle, though it remains frozen throughout the whole year to a depth of twenty inches, covered with bright flowering plants; and the great Humboldt saw at a height of more than eighteen thousand feet, on the uncovered rocks of the Chimborazo, traces of vegetation piercing through the eternal snow of those inhospitable regions. So far from ice and snow being hostile to plants, it has been observed that some of the most beautiful flowers on earth grow in the very highest and bleakest parts of the Alps. There the snow has hardly melted, and lies still close at hand, when

these Alpine roses unfold their brilliant flowers, with a haste, as if they knew how costly were the moments of their short summer-time. They seem to devote their whole strength to the development of their flowers, and as their stems are but short and partially buried in the ground, their bright blossoms often appear to spring immediately from the unsightly drift and gravel, in which they live. Thus growing on the very edge of bare steep cliffs, of vast dazzling snow fields, and dark-blue glaciers, are seen these graceful little plants, decked with a profusion of flowers of the purest and brightest colors. The tiny forget-me-not of the Alps blossoms by the side of huge boulders of rock, and sweet roses unfold their rich crowns at the foot of massive blocks of ice, exhibiting a beautiful picture of loveliness mated with grandeur.

The vegetable kingdom extends its colonies even into the bowels of the earth—the so-called subterranean flora is large and beautiful. Wherever rain or surface water can percolate, either through natural cavities or openings made by the hand of man, there plants will appear, and busily hide the nakedness of the rock. Far below the soil on which we tread, plants thrive and adorn our globe. When the miner first opens his shaft, or the curious traveller discovers a new cave—everywhere they find the rough rock and the snow-white stalactite covered with a delicate, graceful network of an usnea, or, as in the coal mines near Dresden, a luminous fungus shines brightly, and turns these regions of darkness into the semblance of a begemmed and illuminated enchanter's palace. The narrow, deep crevices of the glaciers, have a vegetation

of their own, and even in the thick-ribbed ice of the Antarctic seas, marine plants have been found floating.

Heat deters plants as little as cold; the fiery furnace of volcanoes is tapestried with confervæ, and hot springs, whose breath is certain destruction to animal life, water the roots of plants, which bear beautiful blossoms. There are springs in Louisiana whose temperature is 145° F., and yet not only mosses, but shrubs and trees are seen to bathe their roots in their boiling waters. In the Fumarole, on the fairy island of Ischia, near Naples, a sedge and a fern grow in the midst of ascending vapors, and in a soil so hot that it instantly burns the hand which attempts to touch their roots! Nay, in the very geysers of Iceland, which boil an egg in a few minutes, a small plant grows, blossoms, and reproduces itself annually.

If land and water abound thus with vegetable life, the realms of the air are not less well peopled, at least with germs and seeds of plants; they float upon every breeze, are wafted up and down the heavens, and round and about our great mother earth. Nothing is more startling, more wonderful, than the almost omnipresence of fungus germs in the atmosphere. A morsel of ripe fruit left exposed to the air, affords at once ample evidence of this teeming, living world around us. In a very short time, a delicate, velvet-like covering envelopes the decomposing mass, and presently acquires the utmost luxuriance of growth. And a wonderful race are these fungi, the earth's vegetable scavengers; called upon by the mysterious distribution of duties in nature, to destroy all decaying matter, and to absorb noisome exhalations, they grow with a rapidity that

outstrips decay itself. A very common kind of puff-ball swells, in one night, from a minute speck to the size of a gourd, and there is a fungus found on the continent of Europe, which has been known to increase from a point invisible to the naked eye, to a weight of more than a hundred pounds! Or take the simple mould of every day's life. Arm your eye, and you will behold myriads of delicate forms, standing up in jaunty attitudes, and rearing their tender filaments over the decaying mass, in which they are living in luxurious plenty. They lengthen, they swell, they burst, and again scatter their light and invisible germs, like a cloud of smoke, into the air. There they float around us, like motes in the sunbeam; there we breathe them, for they have been found in the air-cells of birds, and even upon the membranes of the lungs of living men. Our common house-fly may be seen in fall, glued by cold and inertion to the window-pane, and at once covered with its own appropriate mould; in the West Indies, wasps have been observed flying about with plants of their own length hanging down from behind their heads. It is a fungus, the germs of which were introduced through the breathing pores into the body of the poor victim, where they take root, and feeding upon the living substance, develope their luxuriant vegetation.

If we see thus vegetable life on land and on sea, amid snow and ice, as well as on the burning lava, we might well question, whether in this astounding variety of form and home, there can be any law or permanent rule. And yet we find here, also, the handwriting of the Almighty, in clear and indelible characters on every page of the great

book of Nature. Almost every kind of soil has its own peculiar plants; some prosper only on limestone, others on granite, and a few are, as Evelyn quaintly says, "faithful lovers of watery and boggie places." But the distribution of plants shows itself mainly, when viewed in larger masses and groups. As winter is cold and silent, but summer all radiant with forms of life and beauty, so differ Pole and Equator. Near the former vegetable life is nearly impossible; around the other we behold the grandest display of nature's most gorgeous gifts. The glorious tapestry of the earth, we are told by a master of the science, is not woven alike every where, nor is the rich and variegated carpet, with which plants cover the nakedness of the rock, pieced together, without plan or rule, of separate patches. It is, rather, like an embroidering of skilful hands, worked from a grand and beautiful design.

For heat and moisture are the two great requisites of plants: without them no vegetation is possible—heat, especially, is of all their necessaries of life the most important: it is the iron sceptre which rules the vegetable kingdom, whether the plant hang in the air, be half buried in the ground, or for its lifetime covered with water. The same degree of heat produces every where the same union of kindred plants; hence the arrangement of all vegetables according to zones on our globe. The Arctic, nearest to the poles, where lichens still support the reindeer, and cheerful mosses cover the bare rock, is destitute of trees—but it has dwarfish perennial plants, with large flowers, often of beautiful colors; it has its gentle smiling meadows

and green pastures, which we miss so sadly in the sunny South. More varied, and of higher order, is the flora of the temperate zone, though not approaching in luxurious abundance and gorgeous brilliancy the splendor of the torrid zone. But what can compensate for the periodical, anxiously awaited, reawakening of nature, at the first breath of the mild air of spring? What is more beautiful than the fresh evergreen foliage of firs and cypresses, so rare in the tropics, which cheer up the desolate winter landscape, and loudly tell the nations of the north, that, though snow and ice cover the earth, the inward life of plants is never extinguished, and that spring will come after winter as surely as eternity comes after death? The great leading features of the temperate zone are its vast plains and steppes, which the eye of man cannot compass, and where he feels himself, as on the high sea, face to face with his Maker. These large prairies, or savannahs, are covered with luxuriant, waving grass, expressive of all that is cheerful in their airy grace and tremulous lightness. In other regions, strange, fantastic-looking soda plants, succulent and evergreen, strike the eye and dazzle it with their brilliant, snow-white crystals—or, as on Russian steppes, plants of all kinds are so densely crowded on the unmeasured plain, that the wheels of the traveller's carriage can but with difficulty crush them, and he himself is half buried in the close, high forest of grasses, too tall to allow him to look around.

In the torrid zone all vegetable life attains the highest development, from the exclusive and constant union of a high temperature with abundant moisture. Here we find

the greatest size combined with the greatest variety, the most graceful proportions by the side of the most grotesque forms, decked with every possible combination of brilliant coloring. Here also—and here alone—are found truly primeval forests, impenetrable to man and beast, from the luxuriance of thickly interwoven creepers above and the density of a ligneous undergrowth, through which not a ray of light can penetrate.

As the distribution of plants in zones depends almost exclusively on the amount of heat which they require for their development, we find that the succession of plants from the foot of mountains upwards to their summit, is nearly the same as that from the middle latitudes to the poles. For heat decreases in the same proportion by height above the level of the sea as by latitude; and the horizontal zones on a mountain's side present the same variety of plants, as the great zones mentioned, only in a much smaller space, as we feel the temperature of the atmosphere diminish more rapidly in ascending a lofty mountain, than in travelling from the tropics to the poles. Hence the same peculiar plants are found in the arctic zone, and on the highest mountains which reach the line of perpetual snow; the same humble but beautiful flowers blossom in Spitzbergen, or on the icy shores of Victoria Land, and on the desolate cliffs of the Andes, the Alps and the snow-covered heights of the Himalaya. Even under the tropics, the evergreens of the north appear again: the most elevated regions of Peru, and the lofty plains of Asiatic mountains are covered with superb forests of that noble tree of which the poet says:

"Where summer smiles with verdure crown'd,
Where winter flings his storms, the pine is found;
With heaven aspiring head it grows
'Mid burning sun—and everlasting snows."

On the highlands of Mexico, and the mountains of Java, the traveller from the cold north meets with surprise the chestnut and the noble oak of his own distant home. It is one of the most interesting enjoyments offered to the layman as well as to the botanist, thus to pass from zone to zone in the course of a few hours or days at most. Rising, for instance, from the blue waters of the Mediterranean, his eye dwells at first with wondering delight on perfumed orange gardens and dusky olive-trees, "fair and of goodly fruit;" he passes through thickets of fragrant myrtle, laurel, and evergreen oaks, above which tower the stone-pines of the south, and here and there an isolated date-palm, lifting up its gently-waving crown. A few steps further, and the aspect changes; he has left the evergreens of the warmer climate behind him, and stepping out of the glowing, fiery sunshine, he delights in the cool, refreshing gloom of the wide branches of lofty chestnuts and proud oaks, the very kings of the forest. Revived by their luxuriant foliage, "at dewy eve distilling odors," he gazes upwards, where their branches interlace and form grand cathedral aisles, and bows down in awe and reverence in this fit temple of the Most High. As he ascends he meets yet with the maple, spreading out its broad dome of dark green leaves in masses so thick, that beneath it he fears not the passing shower, and the beech, which shows its dappled bark and bright green foliage.

The silvery trunk of some white birch, with "boughs so pendulous and fair"—begins already to gleam among the underwood, when he leaves behind him the aspen with its ever-quivering leaves, which almost shed a sense of breezy coolness through the sultry day.

His next step leads him into the dark woods of truly northern trees: pines, firs, and larches. Their dense shade fills his soul with sombre thoughts; the gentle murmuring of their boughs sounds to his ear like low complaint, and even the sweet aroma that perfumes the air, brings with it—he knows not why—feelings of vague pain and sorrow. He gazes up with amazement at the tallest of the tall, worthy to be

"Hewn on Norwegian hills, to be the mast of some tall admiral,"

and sees in its heaven-aspiring branches and ever-joyous verdure, the true symbol of his own glorious immortality. Now, as he mounts still higher, trees grow fewer and fewer; low bushes stand scattered about, forlorn outposts of their happier brethren below; they also soon venture no higher, and low but fragrant herbs alone remain to greet his eye and cheer him on his way upward. At last he reaches the eternal snow, that knows no season and no change, and stands in unsullied purity, dazzling white, high in the clear blue ether. All traces of life are left behind—he stands there alone in the awful, silent solitude, alone in the presence of his Maker. Thus he has seen in rapid succession, and in a few short hours, what it would have cost him months to behold, had he travel-

led from the same Mediterranean northward to the frozen ocean.

Still more striking is the sudden change in high northern regions, as in crossing the lofty, snow-capped mountains which divide Sweden and Norway. On the south you leave summer behind; as you climb up the steep ascent, misty autumn and cold winter seize you by turns. At last you stand on the very line that forms the water-shed between the two kingdoms, and parts the loving sisters. Huge boulders of dark granite lie scattered about in wild disorder, and gigantic blocks of ice rise in stern majesty before you. Beyond is Norway. As you turn round one of these awe-inspiring masses, behold! a sight meets your eyes that freezes the very blood in your veins. A vast table land, bare and silent, spreads its horrors before you: it is strewn with the bones of hundreds of men, who lay there stiff and cold—not a feature marred—"death had put on so slumber like a form"—but unburied, uncoffined and unknown. They are the sad relics of a whole regiment of brave, blooming sons of Sweden, who had marched into Norway. It was a fierce, bleak day of winter, and as company after company defiled from the well-protected south around the very rock, by which you stand, the cold blast from the pole froze their breath within them, and laid them, one by one, lifeless on the cold ground.

And yet, within a few hours' ride from this most melancholy scene, there lie spring and summer at your feet. You descend, from the eternal snow, through the treeless zones into the faint, fairy sheen of white birch woods, and the dark shade of pine-forests, brightened up by the showy

blossoms of the foxglove—when all of a sudden the sweet odor of fresh-mown hay is wafted upward to greet you. A short hour more, and the almost magical change brings you into the midst of waving fields of ripened corn, and meadows adorned by cherry-trees, which bend under the weight of their luscious fruit, and luxuriantly-blooming roses.

V

Younger Years of a Plant.

"Herbs too she knew, and well of each could speak,
That in her garden sipped the silv'ry dew."

SHENSTONE'S "*School-Mistress.*"

WE all know—thanks to the word of inspiration in our hands—how plants were first made. On the third day, when God made heaven and earth, He said: Let the earth bring forth grass, the herb yielding seed and the fruit-tree after his kind! and the earth did bring forth grass and herbs, the tree yielding fruit, and God saw that it was good.

Thus plants and flowers were the earth's first-born progeny; they sprang out of her bosom and crowned her with verdure and beauty. The plains covered themselves with waving grasses, and the mountains with majestic forests; the silvery willow and the lofty poplar bent over the banks of rivers, and repeated in their trembling, murmuring leaves, the gentle ripple and the low purling of the stream. The ocean, also, had its woods and its prairies

in the depth of its abysses; purple algae were suspended in festoons from the sides of its rocks, and gigantic fucus rose from the bottom of the sea and danced upon the dark green waves. Cedars and pines, with their sombre pyramids, formed dark borders around the white fields of eternal snow and dazzling glaciers. Humble mosses and lowly lichens covered the gray granite of the north, and offered, in the midst of unbroken winter, warmth and food to the reindeer of the Laplander, whilst the palm tree of the south, in its lofty majesty, defied the burning sun of the tropics, and gave shade and luscious fruit in abundance.

So much Revelation itself has told us. The rest is left to that innate thirst of knowledge, the gratification of which is the highest of all earthly enjoyments. Still, we are not quite left to ourselves, for aid is promised us, even now, from on high. "Go into a field of flowers," said the Lord to Ezra, "where no house is built, and there I will come and talk with thee." And who has not felt the truth of good old Cowley's quaint verse:

> "If we could open and intend our eye,
> We all, like Moses, would espy
> E'en in a bush the radiant Deity."

Thus, even now, travellers tell us occasionally, a wondrous tale of barren islands being covered with luxuriant forests, and of naked rocks being clothed with rich verdure. We have learned how nature proceeds, even in our day, to let the grass grow, and the herb and the tree yielding fruit, on spots where before all was sterility, or the elements alone reigned supremely.

For every now and then we hear of some new land, fresh from the hands of the Creator, and destined for ages so distant that human knowledge cannot foresee them. Lava streams that have flown from restless craters, begin at last to cool, and life takes possession of them. Thus in the still hot lava of Mount Etna the Indian fig is planted largely by the Sicilians, to render those desolate regions capable of cultivation. It strikes its strong, well-armed roots into the fissures of the black, fiery mass, and soon extends them into every crevice of the rock. Slowly, but with ever increasing force, the tender fragile fibre then bursts the large blocks asunder, and finally covers them with fertile soil and a luxuriant vegetation. At other times vast tracts of sea-bottom are dyked in and drained; a thousand varieties of mosses gradually fill it up, and form by their unceasing labor a rich vegetable mould for plants of larger growth. Or truly new lands are suddenly seen to claim a place upon our globe. An earthquake shakes a continent and upheaves the mighty ocean, until cities crumble into ruins and the proud ships of man are ingulfed in the bottomless depths of the sea. But the earthquake rolls away, the storm rages itself to rest, the angry billows subside, and the holy calm, which is the habitual mood of nature, is restored as if it had never been broken. Only, where yesterday the ocean's mighty swell passed freely, there to-day an island has risen from the bosom of the deep. Vast rocky masses suddenly raise their bare heads above the boiling waters and greet the heavens above. Such was the origin of Stromboli, of St. Helena, and of Tristan d'Acunha. Or

the busy host of corals, after having built for a thousand years the high ramparts of their marvellous rings, at last rise to a level with the surface; they die, having done their duty in the great household of nature, and bequeath to man a low, flat, circular island which now first beholds the sweet light of day, above the dark waves of the ocean. Then come other hosts of busy servants of the Almighty, to do their duty. A soft, silky network of gay, bright colors, hides after a few days the nakedness of the rock. It is a moss of the simplest kind we know: consisting of single cells and wondrously short-lived. It dies and disappears, leaving, apparently, no perceptible trace behind it; still, it has not lived and labored in vain. A delicate, faint tinge, little more, is left behind, and in that mere shadow of things gone by lies the germ of a future, mighty growth. Years pass, and the shadow grows darker; the spots begin to run together, and then follow countless hosts of lichens, a kind of humble mosses, which the great and pious Linnæus touchingly called the bondslaves of Nature, because they are chained to the rock on which they grow, and, after death are buried in the soil which they make and improve for others only. Little ugly, blackish-brown or pale white plants as they are, but niggardly supported by the thin air of mountain tops, they show us that there are rich garments and humble, wealth and poverty among plants as well as among men. The lowliest and humblest of plants, these lichens become, however, the most useful servants of Nature, which here as in the other works of the Almighty, affords innumerable proofs that, throughout creation, the grandest and

most complicated ends are obtained by the employment of the simplest means. These tiny, faintly colored cups live, truly aërial plants, on the most sterile rock, without a particle of mould or soil beneath them, nourished alone by invisible moisture in the atmosphere. Modestly choosing the most exposed situations, they spread line by line, inch by inch, and push up the little urns which crown their short stems, amidst rain, frost, and snow. In these urns they treasure up their minute, dustlike seeds, until they ripen; a small lid which has until then been held back by elastic threads, now suddenly rises, and as from a miniature mortar they shoot forth little yellow balls, which cover the ground around them. And thus they work on, quiet, unobserved and unthanked. Dressed in the plainest garb of Nature, growing more slowly than any other plant on earth, they work unceasingly until, as their last and greatest sacrifice, they have to dig their own graves! For Providence has given them a powerful oxalic acid, which eats its way slowly into the rock; water and other moisture is caught in the minute indentations, there it is heated and frozen, until it rends the crumbling stone into fragments, and thus aids in forming a soil. Centuries often pass, and generations after generations of these humble bondslaves perform their cruel duty, before the eye can see a change in the rock that still looks bleak and barren.

Now, however, comes a faint but clear tinge of green. It is a mere film still, but visible to the naked eye, and showing the higher and more luxuriant forms of graceful mosses, mixed with fungi which interpose their tiny globes and miniature umbrellas. They come, we know not whence,

for the slightest crevice in the bare rock suffices to arrest some of the invisible germs which are constantly floating in the air, and affords them a home. They yield nothing in industry and perseverance to their humble predecessors; hardy little laborers in the same great work, they seem to delight in the clouds and storms of a wintry season, when all other verdure fades. They find a home, and live and thrive with equal contentment in the burning cinders of volcanic islands, like Ascension, on which they formed the first green crust after it had risen from the ocean, and on the tempest-beaten boulders of Norwegian granite, which they cover with a scarlet coating, well known as the violet stone and full of rich, sweet perfume. As they wither and die, minute layers of soil are formed, one after another, until grasses and herbs can find a foothold: shrubs with their hardy roots now begin to interlace the loose fragments of earth and to bind the very stones to a more permanent structure. The ground grows richer and richer, until at last the tree springs from the soil, and, where once the ocean and the tempest alone beat on the bare rock, there we see now the lordly monarch of the forest raise its lofty crown, and under its rich foliage shelter bird and beast from the spray and the storm. Soon all is fertile meadow, tangled thicket, and wide-spreading forest. Nor is this always and necessarily a slow, painful progress. The bold navigator Boussingault witnessed once, in the south of this continent, one of those stupendous earthquakes which seem to rend the very foundations of our globe. Mountains rose and plains were changed into lakes. Huge masses of porphyry were

scattered over fertile fields and covered all vegetation, changing the bright prairie into a scene of utter desolation. Ten short years later the great captain was again on the same spot. But what a change! The bare wild masses were covered with a young luxuriant grove of locusts, and a thousand cattle were grazing on the hills.

Thus we are taught how nature proceeds, in our day, from the green matter gathering on our ponds to the giant tree of the forest. But if we turn to the individual plant—how little do we as yet know of its simple structure! Who can solve the mystery that pervades its silent yet ever-active life? There is something in the very stillness of that unknown power which awes and subdues us. Man may forcibly obstruct the path of a growing twig, but it turns quietly aside and moves patiently, irresistibly on, in its appointed way. Wood and iron—even powerful steam—they all obey him and become the humble slaves of his intellect. But the life of the lowest of plants defies him. He may extinguish it to be sure; but to make use of a living plant, he must obey it, study its wants and tendencies, and mould, in fact, his own proud will to the humblest grass that grows at his feet. Thus we have learned the biography of plants, few events of which are without interest even to the general observer.

On old walls and damp palings, or in glasses in which we have left soft water standing for several days in summer, we find often a delicate, bright green and almost velvety coat—this is the first beginning of all vegetation. What we see is a number of small round cells, and one of these delicate cells, a little globe as large as the

thousandth part of an inch, is the beginning of every plant in creation. These cells are the living stones of which this great temple of nature is built. Each minute cell, moreover, is an independent plant, vegetating as a living organism and having a life of its own. There are whole races of plants, like the algae and the common mould forming on decaying matter, which consist each only of a single cell, although in varied and often most elegant forms, with a brilliant display of bright color.

The first germ of a plant, then, has already a life—for it feeds, works and produces. It takes all its nutriment from without. How, we know not, for although plants have no table hanging at their gates with a surly No Admittance; although they work, on the contrary, before every body's eyes, unfortunately human eyes are not strong enough to discern the mysterious process that is going on in their minute chambers. Even armed with the most powerful microscope, we cannot penetrate the mystery, and know not yet by what incomprehensible instinct these diminutive cells, all unaided, pick up and select their food, and arrange the new material so as to present us at last with a perfect double of the graceful palm, the queenly Victoria or the gigantic Baobab. It heightens the wonder that all this power lies in a seed minute enough to be invisible to the naked eye, and to be wafted about by a breath of air. And yet it must be endowed with most subtle and varied gifts, for out of the same food plants are enabled to form a thousand rare substances: now bringing forth nutritious and agreeable food for man, now yielding materials most valuable to the arts of life,

and now ministering to the vilest wants of degenerate man and arming him with deadly poison.

But these little cells are not consumers only; they live and work not for the day merely, but for the future also. An almost invisible point in the cell begins to swell and to increase, as it consumes first the colorless fluid, then the soft substance, and at last even the tissue of the outer walls of the cell, until—already at this early stage of vegetable life—death ensues, and out of death comes new life. The old cell dies, giving birth, indeed, as a mother, to other cells, and thus gradually building up the full-grown plant. The young ones leave their former home, after an equally mysterious design, according to the position they are hereafter to occupy in the structure of the plant, and the function they are destined to perform.

Here is the great turning point in the history of vegetable life. All plants consist of cells of the same kind and of the same round or oblong form—but the arrangement and the subsequent shape of these cells differ in each variety of plants. The finger of the Almighty writes on the transparent walls of these microscopic cells as momentous words as those that appeared in flames on the gorgeous walls of the Syrian palace. Only one feature of this wonderful design is permanent and common to all: no cell produces more than two others; of these only one is again productive, it finds a place on the outside, where its activity is unfettered, and dies after it has performed *its* duty. The other remains within, grows harder and thicker, until it can expand no longer; the thickening substance coats the inner walls, fills up the interior, and thus

gives strength and firmness to the beautiful structure. In some plants this development of new cells goes on slowly; in others with truly marvellous rapidity, as in one of the fungi, which forms twenty thousand visible cells in a single minute!

But the minute, delicate form would be but short-lived, and fall an easy prey to the first rude breath of air, if nature did not here also instil the great lesson, that Union is Strength. That wondrous chemical laboratory, contained in the mysterious seclusion of each cell, produces next a cement which permeates the walls, and glues cell to cell, so that, hardly developed, they cannot move from the spot, and, though provided with life and strength for long generations, they are still, like Prometheus, bound for ever on the rock of adjoining cells. At the extremities of plants this glue hardens into a thick varnish; it is this material which gives density and mechanical strength to the so-called woody fibres; *it* forms the bark of trees and covers the plum with a coating of wax. It appears as a viscid layer on the leaves of water plants, which are thus made slippery to the touch and impermeable to water, or as a blue powder on our cabbage, which can be wholly immersed without being wetted. Only here and there, but even in the hardest and fullest cells, tubes of a spiral form are left open. Some are mere small jail windows, imperceptible to the naked eye, and only lately discovered; but they always meet, in unfailing regularity, with a similar tiny look-out from the neighbor, so that Nature evidently does not seem to approve of solitary confinement. Others are larger, and serve as air passages;

for Nature, a good architect, knows the necessity of ventila tion, and provides for it in the humblest of lowly mosses with as much care as in the lofty dome of the universe. In aquatic plants, moreover, these same tubes render them buoyant, as in one of the huge fucus that grow from the bottom of the ocean. All along the immense stem, which reaches from the vast deep up to the light of day, little vessels occur, filled with air, and it is by these tiny balloons, thus continued from story to story, that the enormous leaves of the giant plant are buoyed up, and finally enabled to float on the surface, covering the waves with an immense carpet of verdure. And thus, with unerring regularity, which, in an almost endless variety of forms, still maintains those great laws of Nature that betoken the will of the Most High, these same cells have been formed, not only in the parent plant for its next successor, but during thousands of generations; and that on all parts of the earth, in the same way, the same shape! Well may we, then, with a distinguished German botanist, look upon the vegetable world as the rich altar-cloth in the temple of God where we worship the beautiful and the sublime, because it is His handiwork.

Plants *live*, then, and *feed*. Little do we commonly think, little do we therefore know of the way in which they live and feed. We see animals take their food openly and grossly, in the most conspicuous and eminent part of their body; they tear and swallow, ruminate or masticate. We ourselves do something in that line. But delicate plants hide the coarse process of nutrition under ground, or within the close walls of each tiny cell. There, with

wondrous art, and never resting day or night, summer or winter, they draw a few simple elements, mainly water, from air and soil, and, by their own power and labor, live upon them not only, but manage to obtain all the material necessary for an almost unlimited growth, until the smallest seed has upreared gigantic masses of wood and foliage, and the grain of mustard has grown into a tree, in whose branches the fowls of heaven have their habitation. Each little microscopic cell is its own busy chemist, dissolving all it needs, even small particles of silica, in water, and changing it into food and new substances. The material we know, and the fact that it is introduced—but then we stand again at the threshold of that mystery with which Nature surrounds all first beginnings. The night of the cell, where this strange process is going on, is the same as that in which the grain has to be buried, in order to rise once more to light as a tender blade. We are again taught that the knowledge of first causes belongs to Him alone, who allows the eye of man to see final causes only, and even those, as yet, merely through a glass, dimly.

The general process of feeding, in a plant, as far as known, is simply this: The universal and indispensable nutrient substance, and, at the same time, that by means of which all the rest are conveyed into it, is water. Without water there is no vegetation. The deserts of Arabia, the west coast of Bolivia, and similar regions, are barren, not because they are rocky and sandy, but because it only rains there once in twelve years, and that not always, and they have neither dew nor watery deposits.

This water, with all the materials it may contain, is sucked up by the delicate fibres at the end of roots; thence it rises, probably by capillary attraction, upwards, transuding through the cells by apertures invisible to the highest microscopic power, and filling cell after cell. Here it mingles with the fluid which they already contain, produces new combinations, and is then called sap. Hence these little cells, when searched with the microscope, are found to be filled with an almost incredible variety of good things. Some, it is true, contain apparently nothing but a watery juice, but its virtues may yet be discovered; others are little vials filled with gum or sugar; in many plants they are found to hold just one drop of oil, and in others sugar, or to inclose beautiful crystals of every possible shape. Through these cells the sap ascends, until it reaches the main workshop of plants—the leaves. These bring it in contact with the air, which they in their turn suck in by minute openings and exhale again, after it has combined with parts of the ascended water. It is this continued exhalation of the leaves, and absorption by the roots, which constitutes the circulation, the Life of Plants. They produce a constant interchange between soil and air, and stand in direct proportion to each other. For the sap rises with a rapidity corresponding to the exhalation of the leaves. Hence, in winter, when there are no leaves, there is no sap ascending. Hence, also, in spring the earth sometimes opens sooner than the leaves appear; the sap ascends, finds no outlet, and gorges the tree with fluid. Man comes to its aid, taps the dropsical plant, and draws from the maple its sugar and from

the palm its sweet wine. That part of the sap which is not absorbed in its way upward, and not given out to the air through the leaves, returns again on its mysterious errand, depositing here and there the material most needed, and hoarding up, at intervals, large quantities that are not immediately required for future wants. Such provisions, carefully stowed away, are found in the potato, which is little else than a magazine of nutritive matter, or in the sage of palm trees and the caoutchouc of South America. Lastly, that part of the material imbibed, which is useless or might be injurious—for plants, like animals, may be poisoned—is thrown out again at night in the form of manna or resin; and thus secures the plant from all dangers.

All these features in the life of plants, however, are visible to the microscope only. What we see with the unarmed eye, is not less wonderful. The tiny seed once intrusted to the bosom of mother earth, as soon as the sunlight falls upon it, and genial beams warm the light crust under which it is buried, begins to move and to change. Its starch is converted into sugar and gum, upon which the young plant is to feed during the first days of its existence. The tiny root peeps forth from the husk, and by a mysteriously directed power, plunges downward into the fertile soil, whilst the slender plumule pushes upwards towards the light. The soil cracks and heaves, and at last the infant vegetable being emerges fresh and moist into the world of air and sunshine; with the unfolding of its first pair of leaves, and with the first lighting of a sunbeam on their tender tissues, commences that

series of incessant and as yet secret chemical operations, to which we have before alluded. And the marvel is still increased, when we consider how strangely alike thousands of seeds are one to another, how slight the difference even between the most unlike. And yet, two such tiny seeds, planted in the same soil and living apparently on the same food, produce the one an humble herb, the other a mighty tree. Well may we ask, what wondrous formative power resides there in these little cells, tending exactly in one direction, as though an ideal figure, gradually to be realized, floated already before their infant eyes?

The first business, then, of the young plant seems to be, to settle firmly down in the home which is to see it grow, prosper and die. It sends its roots down into the ground, in a hundred various forms. Sometimes they are divided into a number of slender threads, to penetrate into loose, sandy soil, as in the grasses, that bind the arid sands of the sea-coast together with their long, articulated roots, and thus protect the dykes of Holland against the fury of the ocean. Others are in the form of a single, straight and powerful taproot, to pierce firm, solid ground—or even in long flat scales, which adhere and fasten themselves to bare rocks. Tender, delicate fibres though they be, these roots possess an incredible power. Even in the slim, slender grass they are so firmly interlaced with the soil, that they cannot be torn out without a large mass of earth, and therefore compel us to cut or saw off the straw of our grain. With large trees they serve as gigantic anchors, chaining the mighty monarch to the earth by their powerful and wide-spreading

arms, and firmly supporting it thus against the immense mechanical force of wind which beats above against the large surface presented by its huge branches, covered with dense foliage. In their downward progress they turn aside from no obstacle. The roots of the colossal chestnut-tree on Mount Etna, under whose deep shade a hundred horsemen have easily found shelter, penetrate through rock and lava to the springs at the very foot of the mountain. Massive blocks are lifted up by roots as if with irresistible force. The beautiful trees that flourish amid the ruined temples of Central America, upheave huge fragments of those enormous structures high into the air, and hold them there as if in derision. In fact, the latent energy and slowly accumulated force of these slender fibres in the process of forcing their way through walls and rocks of vast size, is only equalled by the grace of their movement and form; and this union of power and beauty, the one latent, the other obvious, explains, in part at least, the singular charm that the vegetable world exercises over so many strong but susceptible minds.

But roots serve not only as fastenings: they are, as has already been mentioned, the principal avenues for the introduction of food into the plant. They operate by means of most delicate fibres at the end, called spongioles, endowed with so minute openings, that all nutriment to be taken in must be liquid. Nor is it the least of the mysteries of plant life, that these fine, slender roots do not absorb all that is presented to them in a liquid form, but evidently have a power of discrimination. They open or close their minute apertures at will, admitting only

fluids of a certain consistency, and thus select those substances which are best adapted to the growth and welfare of the plant. The finer, suitable material is taken in, the coarser rejected. Repeated, careful experiments have proved this beyond doubt. A grain of wheat and a pea, raised in the same soil, and under absolutely the same circumstances, draw entirely different substances from the earth. The wheat consumes all the silica or flinty matter, that water can absorb, while the pea takes up no flint, consuming, on the other hand, whatever lime or calcareous matter the water of the soil may contain.

Thus the roots of a plant pump up nearly all the nutriment that is required and at least ninety-nine per cent of all the water which the plant needs, the only other part needed being brought by the vapors of the atmosphere and absorbed through the humus. They perform this duty with a vigor little suspected by the inattentive; but if we cut a vine and fasten a bladder to the wound at the time when the sap is rising, it will in a short time be filled and finally burst; and it has been stated that the root of an elm-tree, which was by accident badly wounded, poured forth, in a few hours, several gallons of water.

Not all roots, however, have to perform this difficult and responsible task of extracting food from the earth around them; those of aquatic plants draw it directly from the water itself, as in our common duckweed, where each little leaf has its own tiny root, a single fibre, which hangs from the lower surface. In the mangrove, on the contrary, they form a kind of enormous network in the water, which intercepts all solid matter, that floats down

rivers and estuaries, until the thus arrested and decomposing substances form fever-breeding swamps. When the flood recedes the roots are left uncovered, and often found filled with shell-fish—a fact which explains the wonderful tales of early travellers in the tropics, that there were trees found in the East and West Indies on whose branches oysters were growing.

Other roots have no home in earth or water; they must even be content to hang, all their lifetime, high and dry in the air. Some, it is true, accomplish a firmer settlement, late in life, as those of the screwpine of the tropics, which grow not only at the foot of the tree, but for a considerable height from all parts of the trunk, to protect the plant against violent winds. From thence they hang down into the air and furnish us with a beautiful evidence of creative design in the structures of the vegetable world. They are, namely, at this stage of their growth, provided with a kind of cup at each extremity, which catches every stray drop of rain and dew, and thus enables them both to grow themselves and to furnish nutriment to the parent plant. In the course of time, however, they reach the ground, and instantly these cups fall off, as the roots now need such extraordinary assistance no longer. Others spend their lives, literally, in building castles in the air. Almost all the orchids of the Tropics use a tree, a block of wood, or a stone, merely as a support on which to settle down, and over which to spread their aërial roots. These, however, do not penetrate into the substance; the plants have no other source of nutriment than the vapor of the damp, heated atmosphere

which constantly surrounds them, and from which alone they are supplied with food by those same roots, that thus serve the double purpose of claspers and feeders. Even law-defying squatters are found among the plants, as the mistletoe of sacred memory. It fastens upon some strong, healthy tree, and having no power of forming true roots for itself, it sends out branches which creep through crevices in the bark, into the wood, so that the roots of the parent stem must supply it with food, and the parasitical plant lives, in truth, upon the very life's blood of the tree on which it has fastened itself. Even the stately palm is frequently seen in the murderous embrace of a plant, which is emphatically called the parricide tree. It commences, like every thing vicious, with a small and rather pleasing growth on the trunk or among the branches, then rapidly extends its graceful tendrils in every direction, and increases in bulk and strength, until at last it winds its serpent folds in deadly embrace around the parent tree. The conflict lasts sometimes for years, but the parricide is sure to be victorious in the end, and to strangle the noble palm in its beautiful but deadly coils. The prosperity of the parasite thus becomes an almost infallible sign of the decay of its victim, and a most affecting image of life crushed by a subtle, brute force. And yet it has its redeeming feature in the remarkable fact that these parasites never attack firs or evergreens, but only cover with their foliage those which winter deprives of their glory. The ivy, which often wraps the largest giants of the forest in its dark green mantle, thus appeared to older nations as the symbol of generous friendship, attaching

itself only to the unfortunate, and making its early protector, even after death, the pride of the forests in which he lives no longer—when it gives him new life by covering his lofty trunk and broad branches with festoons of eternal verdure.

Still, wherever roots may be lodged, in the dark, still earth, or under the restless waves, in the damp air of the tropics, or the bark of a foreign tree—they labor without ceasing, night and day, summer and winter. For the life of plants, and the work of their roots, does not cease in winter as is commonly believed, and deep-rooted trees, especially, enjoy the benefit of the warmth which is laid up during summer, in the crust of the earth, and that at the very time when their branches groan under a load of snow, or stand encased with ice and fantastic glittering pendants. Far under ground the roots continue to work indefatigably, until the bright sunshine returns once more, and they feel that the fruit of their industry can again safely ascend through the dark, gloomy passages of the tree, to pass at last into the merry green leaves, and there to mingle with the balmy air of spring. For they are a hardy class of laborers, these roots, and neither cold nor ill treatment checks their activity. It is well known, that the common maple tree may be completely inverted; its branches being buried under ground and its roots spread into the air, without being destroyed. The finest orange trees in Europe, in the superb collection at Dresden, were brought as ballast, in the shape of mere blocks of timber, without roots or branches, in the hold of a German vessel, and found their way to Saxony. Some

curious gardener, anxious to know what plant furnished this new wood, planted them, but unfortunately mistook the upper end for the lower, and thus actually turned the poor, mutilated trees upside down. Yet, in spite of their early mutilation, the long sea voyage, and the subsequent cruel treatment, they have grown and flourished beyond all other orange trees on the continent.

The next step in the life of a plant, after it has thus riveted itself firmly and for ever to its mother earth, is to send its stem or trunk upwards. In doing this, it is evidently influenced by a desire to approach the light of day. This has been proved by experiments as cruel as those that used to shock our sensibilities in the days of early anatomy. Seeds have been so placed, that the light reflected from a mirror should fall upon them from below, and lo! the so-called natural direction of the growth of plants was completely changed; the stem was sent down and the roots grew up! When Nature, however, is allowed to have her own way—which we humbly surmise to be the best—stems grow towards the light, to support the plant in its proper position and to raise it to the requisite height above ground, where it may enjoy air, light and heat. At a certain point, moreover, it spreads out into branches, as the best mode of presenting the largest surface, covered with leaves, to those necessaries of life. Plants are thus enabled to receive the fullest action of light and air, and the branches are, besides, so arranged that they yield readily to the fitful impulses of winds, and quickly return, by their elasticity, to their natural position.

In similar beautiful adaptation to outward circumstances, we find that the stem of the graceful palm-tree is high and slender, but built up of unusually tough, woody fibres, so that it sways gently to and fro in the breeze, and yet resists the fiercest storms, while the lofty bare trunk gives free passage to every breath of air, and the broad flat top tempers the burning sun and shades the fruit hanging down in rich clusters. The solemn and imposing fir tree, on the other hand, branches low, but just high enough to let man pass beneath, and then drops its branches at the extremities, like a roof, exposing, on terrace after terrace, its small fruit to all aspects of the sun, and, in winter, letting the heavy snow glide down on the smooth polished leaves. If the palm were a pyramid like the pine, it would fall before the first storm of the tropics; if the pine were tall and shaped like a broad parasol, the snow and ice of the north would break it by their heavy weight. Yet, both the burning tropics and the arctic zone have their evergreens. At the south it is the towering palm that protects, with its gigantic leaves, all that lives against the fierce heat, and lets the ground be covered with green creepers and countless ferns, to keep it fresh and cool. At the north it is the dark pine, whose lofty, dense pyramid and ample branches, covered with ghastly moss, protect, in like manner, the ground underneath, so that reindeer and man may find their abundance of soft dry leaves and thick layers of downy mosses.

It is this part of the plant which gives it, in common life, its proper rank and name in the vegetable kingdom. When the stem is not woody and dies after the flowering

season, we speak of it as an herb, while a shrub has already a greater size and a stem that branches at the base. The *tree* lifts its head high into the air, and divides mostly above. The stems of *climbers* and creepers are long, thin and winding, whilst *runners* crawl along on the ground or beneath it, and produce new plants at their termination.

The stem has frequently a decided tendency to grow spirally; in creepers it is twisted from the root to the end, the better to enable them to lay hold of and to embrace the objects around which they twine. So it is in all climbing plants and their tendrils, and they derive from this peculiar structure such strength, that they are found, in South America, to form long, slender, but perfectly safe bridges over broad rivers. Even large trees have frequently the same spiral tendency, as we see in many a blasted trunk in our forests, or when we attempt to remove the bark from a cherry tree, which will not tear straight and must be torn off in a spiral.

In the stem, also, we see the main differences of the growth of various kinds of wood in a beautiful variety of grain and wavy lines. Its outside is protected by *bark*, sometimes smooth, as if polished; in others, as in the pine, carved in huge square pieces; hard and invulnerable as stone in the cypress, but cut and cracked in the elm. Most mountain trees have their bark deeply furrowed with numerous channels, to lead the moisture of rain and dew down to the rocky home of their deep buried roots. Dark colored and soft in tropic climes, to resist the heat, it is white as snow in the Arctic regions, and in northern trees, as birches and willows, in order

to reflect what little heat is found in such high latitudes. The bark is, moreover, the last part of a plant that decays, and in some trees may be called almost indestructible. Thus Plutarch and Pliny both tell us, that when, four hundred years after the death of the great lawgiver Numa Pompilius, his grave was opened, the body of the king was a handful of dust, but the delicate bark, on which his laws had been written, was found uninjured by his side.

Not all stems, however, are of the same firm, upright structure. Nature shows beauty not only in the forms themselves, but even more in their endless variety. In the cactus family stems are represented by what we commonly, though erroneously, call their leaves, viz., fleshy expansions, tumid with watery juice, and clothed with a leathery cuticle, instead of bark. Of all cactuses, but one has real leaves: all others possess little more than miserable substitutes in the form of tufts of hair, thorns and spines. These only, as far as they go, are their true leaves. The stems, it is well known, display in this same family an unusual variety of odd, outlandish-looking shapes. Now they rise, under the name of torch-thistle, in a single branchless column to the height of forty feet; and now they spread their ghastly, fleshless arms in all directions, like gigantic funereal candelabras. The melon-cactus imitates, in shape and bristling spines, the hedgehog to perfection, whilst the so-called mammillaria are smooth or ribbed globes of all sizes. Others, at last, grow longitudinally, like the long whip-like serpent-cactus, which swings ominously from the trees on which it lives as a

parasite. Nature, however, has made them ample compensation for their uncouth appearance and gloomy, wretched aspect, by giving them a profusion of flowers of unsurpassed brilliancy.

The snake-like form of the last mentioned cactus is still more strikingly presented in the stem of the lianes of South America. They are almost entirely stem. Stretched out like the strong cordage of a vessel, on which tiger-cats run up and down with wonderful agility, or winding serpent-like in and out, now as cords and now like flat straps, they extend frequently more than a hundred feet, without leaves and without branches. In the primeval forests of the tropics they may be seen hanging from tree to tree, often ascending one, circling it until they choke his life's blood in him—then wantonly leaping over to another—next falling in graceful festoons, and then climbing up again to the topmost summit of a palm, where, at last, they wave perhaps their bunch of splendid flowers in the highest, purest air. Repulsive in themselves, these *lianes* also grow beautiful by the contrast they present with the sturdy monarch of the forest, around which they twine, a contrast which yet, as every thing in nature, produces harmony. How different are these stems again from the beautiful structure of the various grasses! Here a slender column rises, sometimes to the height of a few inches only, as in our common mountain grasses, and then, again, in the bamboo, to a towering height, waving their wide-spread tops in the evening breeze, or growing like the gigantic grasses on the banks of the Orinoco, to a height of more than thirty feet, where they

have joints that measure over eighteen feet from knot to knot, and serve the Indians of that country as blowpipes, with which they kill even large animals. And yet the delicate graceful tissue of all these grasses resists, by their wondrous structure, the storm that would break columns of granite, of the same height and thickness! Nature knows full well that a slender hollow tube, with well strengthened walls, the most solid parts being placed outside, is the best form in which to give firmness and solidity to such structures. Hence it is that their delicate walls are hardened by a copious deposition of silica, so that *e. g.* a kind of rattan has solid lumps of it in joints and hollows, and will readily strike fire with steel; and the so-called Dutch rush, a horsetail moss, is largely imported from Holland for its usefulness in polishing furniture and pewter utensils. The grass which grows on less than half an acre of land is said to contain flint enough to produce, when mixed with sand, and by the aid of the blowpipe, a glass-bead of considerable size; and after a number of hay-stacks, set up by the river side, had once been struck by lightning and burned, large lumps of glass were found in their place. Wondrous indeed are the works of the Almighty, and well can we understand the deep pathos with which Galileo, when questioned as to his belief in a Supreme Being, pointed at a straw on the floor of his dungeon and said: "From the structure of that little tube alone would I infer with certainty the existence of a wise Creator!"

Other stems, like our bulbs, whose scales are the real leaves of the plants, grow under ground, where they alone,

well protected from cold and tempest, live through the dreary winter season. Or they are hid by the water in which they live, and then frequently reach an almost incredible length. Some marine algae have been found more than fifteen hundred feet long; they branch off as they approach the surface, until they form a floating mass of foliage, hundreds of yards square. These stems resemble cords in every variety of form and twist, and are used by the natives of the north-west coast, where they are most frequently found, as fishing lines—while others of the same kind are dried to serve as siphons, or are formed by the natives into trumpets, with which they collect their roving cattle at nightfall. The most remarkable stem, however, of all more common plants, is probably that of the valisneria, an aquatic plant which grows at the bottom of rivers. It consists of long, elastic cords, twisted like a corkscrew, and sends some branches up to the surface, while others remain below and are completely submerged. When the flowering season approaches, the plant shows an instinct so closely approaching conscious action as to startle the careful observer. Some of the flowers are produced below, where they cannot exhibit the beauty of their frail blossoms; these begin to stretch and to twist, as if they longed for the bright sunshine above, and at last they succeed in breaking loose from their dark, gloomy home. In an instant, they rise to the surface, being lighter than water, expand there under the benign influence of light and air, and mingle their dust with other flowers, which are already floating there. This "high" life continues until the seeds are beginning to ripen, when

the elastic stems contract once more, and, with like wonderful instinct, carry the seed vessels down and bury them in the watery bed of the stream, where alone they can hope to find all the requisites for their future growth and welfare.

The stems or trunks, finally, indicate in all long-lived plants the age with unerring accuracy. Their growth being limited only by external causes, the years of trees are seen in their size, and this union of age with the manifestation of constantly renewed vigor, is a charm peculiar to the life of plants. Animals, however curious, beautiful or imposing, have still a limited size and figure—plants alone grow without limit, and bring forth new roots and new branches as long as they live. This gives to very ancient trees, especially, a monumental character, and has ever inspired nations with a kind of instinctive reverence, which from the days of antiquity to our own has often degenerated into open worship. Who has not heard of the oaks of Mamre and the pilgrimages made to them from the time of Abraham to that of Constantine—or of the far-famed cedars of Lebanon, which have always been distinguished as objects of regard and veneration, so that no threat of Sennacherib was more dreaded than that he would level them to the ground? Herodotus dwells with delighted sympathy on the marks of respect with which Xerxes loaded the famous plane-tree of Lydia, while he decked it with gold ornaments and intrusted it to the care of one of his ten thousand "Immortals." As forest trees increase by coatings from without, the growth of each year forming a ring round the centre of the stem, the

number of years is usually ascertained—since the well-known author Michael Montaigne first started this theory—by counting the concentric rings. Care must, however, be had not to forget, that some trees begin to form these only after several years' growth, and that, whilst northern trees shed their leaves but once a year, and therefore add but one ring during that time, those of the tropics change their foliage twice or thrice a year, and form as many rings. This renders the age of such trees, as were heretofore considered the oldest, somewhat doubtful; still there are some remarkable cases of longevity well authenticated. Humboldt measured a gigantic dragon-tree near the peak of Teneriffe, and found it possessed of the same colossal size, forty-eight feet round, which had amazed the French adventurers, who discovered that beautiful island more than three centuries ago—and yet it still flourished in perpetual youth, bearing blossoms and fruit with undiminished vigor! Some yew trees of England, and one or two oaks, claim an age of from one thousand four hundred to three thousand years, and would, if their claims were substantiated, be the oldest trees in Europe—but a famous baobab, on the banks of the Senegal, is believed to be more than six thousand years old, in which case its seed might have vegetated before the foot of man trod the earth! Its only rival is a cypress tree in the garden of Chapultepec, which Humboldt considers still older; it had already reached a great age in the days of Montezuma. A curious old age is that of a rose-bush which grows in the crypt of the cathedral of Hildesheim, in Germany; it was there planted by the first founder of the church, and is expressly men-

tioned in the MSS. in which his donation and the building itself are described; it also flourishes still, and bears as fragrant roses in these years of change and revolution, as eight hundred years ago, when Germany was one and great!

Most plants are accustomed—we hope not for their sins—to cover themselves, like our first parents, with leaves, and it is well established now, that the plant, properly speaking, consists only of stem and leaves—all other parts, like buds, flowers and fruits, being only modified forms of leaves. These are mostly green, and the depth of their color is an indication of the healthfulness of their action. But there are a hundred shades, and the color invariably contrasts most beautifully with the back-ground, on which the plants appear. The humble moss shines with its brilliant emerald green on the dark sides of rocks, whilst mushrooms display their gorgeous scarlet and orange between the sombre rugged roots of the trees, under whose shadow they love to dwell. The glossy color of the ivy looks all the more cheerful by the gray bark of crumbling ruins, which it hides with the folds of its warm mantle, and vies with the carpet of verdure that vines spread over old turrets or the fallen trunks of ancient trees, whilst in fall they reflect permanently the gold and purple of the setting sun. But, here also, beauty is not given to all with the same lavish hand. Whilst the queenly Victoria floats its richly-tinted leaves in gorgeous beauty on the dark mirror of calm, shady lakes, the poor lichens of the north shiver in their scanty coat: gray and withered in the shade, they look, when lighted up for a

brief noonday time, like gigantic snow-crystals, and cause a chilly shudder. In Australia, where all extremes meet, from the bird-fashioned quadruped to the millionaire convict, the leaves of trees and bushes have a leathery look and are oddly twisted, turning their edges up and down, instead of standing horizontally, as with us. They afford no shade, and are covered with a white, resinous powder, which gives them a most dismal and pallid appearance. Yet—whatever form leaves may assume—their wonderful adaptation to their great duty strikes us in all plants alike. The immense extent of surface which they present to light and heat, the thinness and delicacy of their structure, the microscopic beauty of their minute apertures, their power of breathing in and out—all answer admirably the great purpose of exposing the crude sap, that rises from the root, to the air and the sun, to be by them digested into highly nutritious food.

All leaves change their color in autumn, when a peculiar chemical change goes on in their substance, and takes the bright, fresh green from them, to leave them in sad-colored livery, or to clothe them, as a parting gift, in the brilliant drapery of an Indian summer. It is then that, especially in American woods, a combination of hues is produced, which no painter can hope to imitate, when the maple burns itself away, and "all the leaves sparkle in dazzling splendor with downy gold colors dipped in heaven." Not less variety may be perceived in the *shape* of leaves. Needle-shaped in northern evergreens, they are gathered, like tiny brushes, to collect at every point whatever heat and moisture may surround them. Plants

growing in arid places, or high mountains, have leaves shaped like cups, with broad channels to conduct the precious water of dew and rain to their roots. In trees bearing cones they are dry, pointed and narrow; they seldom rustle, being silent; but, as a compensation, they are ever green. Their high polish enables them to reflect what little heat they can gather in northern lands, whilst the light may still pass between them with ease. On catkin-bearing trees they are broad and tender, so that the gentlest wind gives them motion and sound, a charm wholly wanting in evergreens; but their time is short, and they perish after a season! As we approach the equator, we find leaves without polish, so as to reflect no heat, placed horizontally to form a shading roof. They grow broader and larger, with every degree, until the cocoa-palm has them more than one foot square, and a single leaf of the tallipot-palm of Ceylon can cover a whole family. Those of the waxy palm of South America are, moreover, so impermeable to moisture, that they are used as coverings for houses, and have been known to stand all the vicissitudes of the weather for more than twenty years, without being renewed. They thus form a screen by day, a tent by night, and become eminently useful in a land which is half the year burnt by a scorching sun, and the other half completely under water. In like manner leaves change according to the wants of the tree, whose ornament and best servants they are at the same time. The oak of our mountains has thick, broad leaves—that of the seashore, which we call willow and live oak, is satisfied with thin narrow leaves. The honeysuckle changes them at will

into tendrils, the pea into hands with three or five fingers, with which to grasp its support, though only when it has reached a certain height, and needs the latter; the passion flower converts them into cork-screws, whilst the common nasturtium is content with a simple hook at the end of the leaf. Their arrangement also around stem and branches is not left to accident: a distinguished mathematician of *our* Cambridge once astonished a large and learned audience not a little, when he informed them that plants knew mathematics, and arranged their leaves according to fixed rules. A spiral line drawn from the base of one leaf, around the stem, to that of another, shows regular intervals between them, which vary in different plants, but are in each carefully and strictly observed.

The great purpose of life in leaves is to carry on their most active and important vital function—their respiration. They are the lungs of plants, not condensed, as in man, in one organ, but scattered independently in countless numbers over the branches. For the purpose of breathing they are endowed with innumerable and often invisible little openings, commonly on both sides—in aquatic plants, however, whose leaves float on the surface of the water, only on the upper side. In the cactus tribe these are almost wholly wanting, hence the latter are so succulent, as they retain all the fluid that their roots have sucked up, and exhale nothing. Their activity is, of course, a twofold one, as they both take in and give out, without ceasing. They inhale atmospheric air, appropriate its carbon for the formation of their juices, and return the separated and disengaged oxygen in the form of gas. This

process, however, can only go on during daytime, as light is indispensable—and is performed by all the *green* parts of a plant alike. It is this incessant labor which makes plants not only an ornament of our earth and a food for man and cattle, but renders them so eminently useful in the great household of Nature. They absorb the carbon, that man cannot breathe, and furnish, in return, the oxygen, without which he cannot exist; thus virtually, by their industry, rendering the atmosphere fit for the support of animal life. Besides the exhalation of oxygen, the leaves also evaporate nearly two-thirds of the water which the roots have imbibed, and sent up to them through the interior of the plant. The moment this now perfectly pure water is exhaled, it is dissolved in the air, and becomes invisible to the eye.

Another duty, which the leaves of plants perform with still greater energy, is the drawing of water *from* the atmosphere. They drink it in, from the first moment of their short life, to the last day, by all possible means and contrivances. The young leaves, as yet wholly or in part rolled up, are but so many cups or spoons, turned to heaven to gather all the moisture they can hold. As the young plants grow, they unfold leaf after leaf, and all perform the same duty with the same eagerness. From the cedar of Lebanon down to the bashful violet, each plant holds forth its gigantic mass of foliage or its tiny goblet, to have *its* share of the precious moisture. A glance shows us that leaves have generally a little canal passing from the end up to their base, in which the water they have gathered runs down; and it has been observed

that the drier and sandier the soil is on which plants grow, the more deeply furrowed are their leaves. In large trees, therefore, a constant stream of water flows from the end of the leaf to its stem, and from branch to branch until it reaches the trunk, and then in the deep furrows and crevices of the bark down to the roots, so that not a drop of the precious nutriment is lost. Water-plants, on the contrary, needing no such ingenious contrivances, as they have an abundance of the element all around them, display smooth leaves, often so highly varnished that the water runs off or stands in silvery pearls on the dark green surface.

All plants are greedy consumers of water, and know how to obtain it, by some peculiar, as yet unknown process, even in such regions of the tropics, where for half the year no cloud darkens the ever-serene sky, and where not even dew is given to refresh the panting vegetation. Their power, in this respect, is as great as it is mysterious. The most succulent plants of the tropics cling to the faces of barren cliffs, or rise from dry, dust-like sand. It is true, their leaves contain both caoutchouc and wax, and are covered with a thin layer of these substances, as with a water-proof cloak, to prevent evaporation under a burning sun. Some plants, however, support themselves not only, but actually increase in weight when suspended in the air, and unconnected with any soil, as the common houseleak and the aloe. The so-called air-plant, perhaps the most remarkable of the whole vegetable kingdom, is but a single leaf, without stem or root, and yet it is able to maintain life, to grow and to blossom, if only hung

up in a warm and damp atmosphere, though it be not even in contact with any other substance. It puts out buds, these become leaves, drop tiny roots into the air, and soon exist as independent plants.

And here again we cannot help observing, how quietly the work of Nature is going on, unsuspected and unheeded by others. The innumerable leaves of our forest and arbor trees form a vast summer laboratory, in which the great work of plants is incessantly continued, and which contributes, to an incalculable extent, to the support and the health of all animal existence. They afford us thus another of the countless proofs of creative design, which we may, at a glance, obtain from the vegetable world. They labor and work for themselves apparently all the while, but render the earth and all life thereon invaluable service. Even when they greedily draw up all moisture by roots or leaves, they become our benefactors. The despised mosses hold up their little cups to collect the waters of heaven, and make most ample return for its bounty. They clothe the steep sides of lofty hills and mountain ranges, and their densely-crowded delicate leaflets attract and condense the watery vapors constantly floating in the air, and thus become the living fountains of many a proud stream. The tall trees of the forest draw down the rain-filled cloud, as the lightning-rod invites the thunder storm, and the moisture so distilled is condensed into little streamlets which trickle down from twig and bough, even when the ground is dry and dusty. This gives fertility even to adjoining fields. The heavy, damp air, gathered by the woods, sinks down as fog or mist when the still

cool evening comes, and rich dew pearls in the morning on the meadows, and refreshes the fields. Trees thus affect materially the climate and general character of countries. Thickly-wooded regions, like our own continent, are colder and more humid than cultivated or broad treeless savannahs; they abound in rain and fertile dew; and to cut down our trees is seriously to impair the supply furnished by them to springs and rivers. Some lands would not be habitable but for trees. In one of the Canaries neither springs nor rivers are found; but there grows a large, tall tree, called with veneration the *Saint*, in some of the deep recesses of the mountains. It keeps its lofty head all night long wrapped up in mist and clouds, from which it dispenses its timely, never-ceasing moisture in little rivulets, running merrily down from the leaves. Small reservoirs are built for the purpose of catching the precious gift, and thus alone the island is made a fit dwelling-place for man.

Humbler plants store up water in smaller quantities, but not the less pure or welcome. The melon cactuses have been called the vegetable fountains of the desert, because they conceal under their hideous prickly envelope, covered with dry lichens, an ample supply of watery pith. The great Humboldt tells us graphically, how, in the dry season, when all life has fled from the pampas, and even snakes lie buried in the dried-up mud, the wild mule, perishing with thirst, gallops up to the ill-shapen plants, strikes with its hoofs at the powerful prickles, until it has made an opening, and then warily approaches, with long protruding lips, to drink the well-defended, cool and refresh-

ing juice. Brazil, also, has a plant—the rainy one, it is called—that is remarkable for a constant flow of water from the points of its leaves, which falls upon the parched ground like a gentle shower of rain-drops. Quite a number of plants, it is well known, have regular pitchers, in which they accumulate moisture—some from within, and others by holding them open in rain or damp weather and closing a curiously-fashioned lid, when they are filled. Such are the side-saddle flower of our own country, with leaves like pitchers, covered with a top, and half full of water; the monkey-cup of South America, to which it was once believed the monkeys resorted to quench their thirst, and the distilling nepenthes, which hold up their capacious and elegantly-formed pitchers, full of cool, colorless water, in the burning sands of the desert. A few trees change the nature of the fluid, and one, the cow-tree, is even good enough to satisfy hunger as well as thirst. It yields a rich, bland and oily juice, closely resembling milk, and that in sufficient abundance to refresh and to satisfy the hunger of several persons. But if the leaves of plants are so industriously and incessantly at work, it must not be forgotten, that some go regularly to rest, and sleep so profoundly that in a clover-field not a leaf opens until after sunrise, and others in South America are universally known as the "*sleepers*." Most mimosas fold up their delicate, feathery leaves, as night approaches, and when the sun rises once more, the little sleepy ones unfold again, slowly, and, as it were, reluctant, like some of us, to begin their work anew. It has even been observed, that these so-called sensitive plants, when wounded

or otherwise suffering, cannot sleep, but keep their leaves open and erect all night long, until they perish. Other plants close their leaves during the day, and awake from their slumbers at night, while a few even droop and clasp the stem, as if seeking support in its strength, whenever the sky is overcast and a storm is threatening.

This peculiar faculty of sleep stands in immediate connection with the general power of certain leaves to move, either upon coming in contact with other bodies, or, apparently, in spontaneous motion. All the above-mentioned mimosas fold up their leaves, when merely touched; first one little leaflet will be closed, then another, until the whole leaf proper, with its delicate footstalk, droops down and clasps the stem of the parent. If the plant be very irritable—and nervousness is *here* found to be in proportion to *good* health—the other leaves will follow the example, until the whole little plant plays, to use a Virginia phrase, "'possum," and looks, for all the world, as if it were asleep. The oxalis of this continent requires several successive strokes to produce the same effect, and the robinia, our locust, which sleeps at night, must be violently shaken. The common wild lettuce, also, shows a great irritability, and, curiously enough, only when the plant is in flower. Upon being touched, the leaves contract beneath, and force out, above, a milky juice, with which they soon become covered.

The so-called spontaneous movements of leaves and other parts of plants arise mostly, though not always, from their general tendency to turn towards the light. Little is as yet known with accuracy of this interesting

feature in the life of plants. A great number of leaves, however, alter their position by night and by day. Some make a half, some a quarter revolution, and then turn their points downward. Others, again, fold up, in regular order, the youngest leaf first, as if it required most rest, whilst the oldest are apt to do entirely without it. In other plants it is the state of the atmosphere which determines such movements—the beards of the geranium and the wild oat curl up in dry weather, and straighten again in damp days—other plants do the contrary. The hygrometrica of South America closes the leaflets of its finely pinnated foliage long before the clouds rise, and thus foretells the impending change of the weather, and the plant, known among us as the fly-trap, is called in its home on the warm plains on the banks of the Senegal, the good-morning flower, because at that season of the day it gracefully bends over and bows to the passer-by. On the banks of the Ganges, however, exists a vegetable form, so quick of life as to resemble some of the minor animals in its motion. The leaflets of this singular plant are in perpetual motion: one leaflet will rise by a succession of little starts and then fall in like manner; while one rises, another droops, and thus the motion continues and extends over the whole foliage. Nor does it cease at night; in fact it is said to be more vigorous even in the shade, and in the still, hot hours of an Indian summer-night the plant is full of life and incessant motion. Not less singular is the action—for it is more than motion—of plants, like Venus's fly-trap, and others. The flowers are covered with sweet honey, and thus allure many an unfortunate insect,

which has no sooner touched the sweet store, than the plant moves either the long stiff hairs, which grow along the middle nerve, or closes its crown of gorgeously colored leaves above, and thus seizes upon the unlucky robber. We can speak no longer of sweet innocent flowers—for so fond are these blood-thirsty plants of their favorite delicacies, that they will not thrive in green-houses from which insects are excluded, and gardeners have been compelled to supply them, strange as it may sound, literally with animal food, to see them thrive and blossom as in their native home!

VI.

Later Years of a Plant.

"Soft whilst we sleep beneath the rural bow'rs,
The loves and graces steal unseen away;
And where the turf diffus'd its pomp of flow'rs
We wake to wintry scenes of chill decay."—SHENSTONE.

THE true, full life of plants may be said to begin and to end with their period of blooming. Whilst trees do not blossom until many years have passed over their lofty heads—the fir-tree and the beech, for instance, seldom before the fiftieth year—the humbler plants look upon the time when they are crowned with flowers as the happiest—and last, of their existence. It comes, with some, after a short year, whilst the Agave Americana lives many, though not quite a hundred years, without ever flowering. Then it produces, with amazing rapidity, an innumerable host of flowers, growing almost visibly, until it has unfolded its magnificent candelabrum of nearly fifty feet high, and then it perishes. So also the beautiful talipot palm: it grows and flourishes, and forms a vast crown of broad leaves at a great height; then only it flowers

for the first time, produces its seed and dies; so true is it, that

> "He bids each flower his quickening word obey,
> Or to each lingering bloom enjoins delay."

Plants, however, have not only their age of blooming, but also their season. Whilst most of them open their bright chalices in spring or midsummer, when "the sun smiles on the earth, and the exuberant earth returns the smile in flowers," others do not bloom until fall or even winter. The autumnal crocus, which gives us saffron, blooms not until almost all the other flowers are gone. The black hellebore sends its pale green flowers as a Christmas present, and the fragrant blackthorn blossoms, while the cold north-east winds blow, in spite of cold and frost. The vernal crocus sends up its golden cups in early March, however cold it may be in the reign of what Coleridge calls "the dark, frieze-coated, hoarse, teeth-chattering month," and the silvery almond flower blooms on a leafless bough. Nay, the very hour of blooming is appointed to plants with mysterious accuracy. A few years ago I went to see, near Upsala, the cottage of old Linné, the father of modern botany, and among all the precious relics carefully preserved, near his home, there was no token of the pious reverence with which his countrymen honor his name, more touching than his floral clock. In a half circle, carefully arranged around his writing table, stood a number of plants which opened their flowers each at a certain moment, so that they revealed at a glance to the great master, the hour of the day, with unerring precision. For, as every bird has his hour when he awakes

and sends up his hymn to praise his Maker, so every flower also has its time. They open commonly to the light, some in the morning, to close again at night, whilst others will not open at all, except in clear bright weather. The degree of light which they require, determines mostly the hour of the day at which they will unfold their beauty. Thus the daisy, like a true day's eye, opens its white and crimson-tipped star to meet the early beams of the rising sun; and the morning-glory closes its sweet-scented flowers before the sun has risen high; the dandelion opens at half-past five, and closes at nine; the scarlet pimpernel waits patiently until mid-day, and dreads rain so anxiously that it folds quickly up, even before the impending shower, and remains closed during the passage of a cloud. Hence its name of the "poor man's weather-glass." Others love late hours: the evening primrose opens its golden eyes in the sweet hour of eve, and retires before the returning glare of day. The brilliant white lotus, opening when the sun rises, and closing when he sets, still loves shade so well, that, when it has no shelter to screen itself, it folds up its pure leaves as soon as the sun reaches the zenith, as though unable to endure the too ardent rays of the luminary that called it into life. There are, on the other hand, also bats and owls found among plants, wide awake all night long. The convolvulus of the tropics blooms only at night, and so does that magnificent cactus, the large flowered torch-thistle. Late in the silent night, when all other flowers are sleeping, this strange plant, with its dry, bare stem, unfolds its gorgeous, vanilla-scented flowers. There are few others known of greater beauty; they some-

times measure a foot in diameter, and when several of these magnificent creatures are open at once, upon the same plant, they seem like stars shining out in all their lustre, and verifying the poet's assertion, that

> "Darkness shows us a world of light
> We never see by day."

But it is a short glory indeed: at midnight they are fully blown, as soon as the morning dawns upon them, they fold up their charms, and a few hours later they are decayed, leaving not a trace of their gorgeous beauty behind them.

Not all plants, it is well known, have flowers "to gaze on us with gentle, child-like eyes;" the ferns and allied plants bearing seed without apparently blooming first. Where they occur, however, they are only a collection of several circles of more or less transformed and bright-colored leaves, which mostly alternate with each other. In the centre of these circles stand the reproductive organs, and a minute dust is generally found on the petals, apparently resting so lightly on them, that a breath of air might blow it away. The variety of their color is surpassed only by that of their shape. The purest colors occur in Alpine plants, where living flowers skirt the eternal frost; it is among these that we must look for the loveliest sky-blue, the purest snow-white, and the most beautiful rose-color, until we reach the very glory of luxuriant rhododendrons forming a bright purple girdle around snow-covered peaks. By their side the flowers of the plain look impure and stained. But they have no odor, fra-

grance being given to the children of the low lands only. So with man—it is not proud beauty that is most lovely; there is a far more potent charm in the sweet perfume that surrounds the meek and the gentle. Trees are different, for here Nature seems to have wished to compensate the north for the absence of gay colors, by giving sweet odors to whole classes of plants. Thus the numble reed is there aromatic enough, to form with sugar a favorite luxury; as dew falls there spreads abroad the fruit-like perfume of the golden furze; the birch-tree exhales in early spring a sweet rose fragrance, and the pine is aromatic from the root to its graceful cone. Some flowers have unpleasant odors. The largest on earth, which takes its name from its discoverer, Raffles, and which is more than three feet in diameter, has an animal smell, closely resembling that of beef, and the so-called friar's-cowl smells so strongly of spoiled meat, that it deceives the blue-bottle fly, and tempts it to deposit its eggs there, as if it were carrion. Poisonous plants have, generally, a sickening and noxious smell, like our aconites, the ailanthus, and Kentucky locust, which exhale a subtle poison, and are fatal to many insects. In all instances, however, fragrance is given to plants for some special and beneficent purpose, mostly to attract animals, and to tell them where a table is spread for them. It is well known that all animals smell what they want to eat, often at a prodigious distance, and as Nature calls by their smell the vulture and the buzzard to perform that duty, which is their highest enjoyment, so all theory of botany lies, with animals, in their exquisitely developed smell. Nor ought

we to omit mentioning here, in humble gratitude, that Columbus, when his crew mutinied, and his brave heart nearly failed him, felt his hopes revived and his courage restored by the sweet odor of sassafras, which the land-breeze brought upon its wings from the distant shores of the New World.

The oddest shapes of flowers are probably found among the orchidaceæ of this continent, whose flowers, rich in every shade and variety of color, portray in their extraordinary formation almost the entire scope of animated nature, beasts, birds, and fishes. Some represent a helmet with its visor up; others look like ants and larger insects. The bee and the fly, the spider and the lizard, are each accurately copied in certain varieties; one looks for all the life like a dove, and is irreverently called the Holy Ghost; and another resembles a large and beautiful butterfly so closely as to deceive even the instinct of birds.

It is perhaps one of the most curious, and, as yet, most mysterious features in the life of plants, that the appearance of flowers is in some instances accompanied by very remarkable phenomena. In many of our creepers, in the lilies and the common gourd, a kind of fever-heat is perceptible at the time of inflorescence. Sometimes it appears in paroxysms, then again it rises and falls regularly, and so distinctly, that in one plant, which has perhaps only been subjected to more careful observations than others, the heat has been noticed to increase daily from 60 to 110, or even 120 degrees, and then again to fall to the temperature of the atmosphere. Some have thought that this very striking peculiarity of certain flowers might

be connected with the power of others to emit light. The gentle daughter of Linné, when walking on a dry, sultry summer evening through her father's green-house, first observed flashes of phosphorescent light on a few plants. Since then others also have been found to be so endowed, and the common nasturtium of our gardens, if plucked at the time of a bright sunshine, and at once carried into a dark room, will become visible to the eye, after a while, by a gentle light emitted from its leaves. In fact, most of our yellow or orange-colored flowers, our marigold and monkshood, will in serene summer evenings give out light, either in the form of sparks, or in a steadier, but more feeble glow. In a few plants this peculiar gift is not limited to the flowers only, but common to all leaves. Thus many lichens, creeping along the roof of caverns, lend an air of enchantment to them, by the soft and clear light they diffuse, while another plant, abounding in the jungles of the Madura district in the East Indies, gives such an extraordinary vivid light, that it illuminates the ground around it for some distance.

Equally striking and peculiar is the clear, loud sound with which the golden or dazzling white flowers of certain palm-trees open—a sound already noticed in times of antiquity, as we learn from Pindar, who speaks of the season, when "the first opening shoot of the date-palm proclaims the arrival of balmy spring." This, however, seems to be the only exception to the general stillness, with which Nature proceeds in her work, ever showing how calm and unpretending the growth of every thing beautiful is in God's visible world. It is a frequent re-

mark that "we never hear a rose opening or a tulip shooting forth its gorgeous colors," and yet of the same quiet flowers it was said: Consider the lilies of the field: I say unto you, that Solomon, in all his glory, was not arrayed like one of these!

When the beauty of flowers is gone, their leaves drop quietly, silently to the ground; but a part of the flower always remains attached to the stem, and this contains the fruit or the seeds of the plant by which it continues its existence and reproduces itself. It is in the process of preparing these parts that plants show most distinctly how well they know what time of the year it is. In autumn they feel that winter is coming, and prepare for it, by completing all the necessary processes with far greater activity than they have shown at any other period of their life. It is, of course, not an innate consciousness of the season that impels them to do so, but an extremely delicate and now much heightened perception of outward influences, inappreciable to our less refined senses. The production of seeds is the great end of the life of the majority of plants, though not of trees and all those who live for many years. But the humbler plants see in it the great purpose of their existence: for this they have grown and worked and lived, for this they have unfolded the whole rich apparatus of flowers, and now their best cares are bestowed upon the ripening fruit. No precaution is neglected to preserve it; the little capsules which hold the precious seed of future generations, are surrounded with thorns, or covered with down, cased in leather, buried in large masses of succulent flesh, or

carefully packed away in hard, air-tight shells. A mother could not have better care for the cradle of her beloved one. Then, when the seed is ripe, and has to be turned out into the wide world to seek a resting-place and a home, it is furnished with a crest of feathers, or intrusted to a tiny embarkation. Nature gives it wings to fly with or a boat to swim in. And so admirably is the minute grain protected, that the smallest have often survived for centuries. Raspberry-seeds, it is well known, have been found in a barrow, thirty feet deep, alongside with coins of the Emperor Hadrian, and yet, when sown, they have borne fruit. The pyramids of the Pharaohs are crumbling into dust, but the grains of wheat, found in their interior and once more intrusted to the tender care of their mother earth, have joyously sprouted and made an ample return.

The fruit undergoes, of all parts of the plant, perhaps the largest number of remarkable changes, even after it has already reached its full size and complete shape. Acid whilst growing, it becomes sweet as it ripens, and is sugary when perfectly mature. Fermentation makes it vinous, and, dried up, it turns sour or bitter. Fruits vary in taste, apparently to suit, by the kindness of an All-wise Providence, the changing wants of man. During the oppressive heat of summer, nature ripens for him juicy and refreshing cherries, peaches and melons; the more sugary figs and mulberries disappear as fast as the bright days that produced them. When the warm sun is leaving us, and cold chills begin to threaten, more vinous fruits ripen, like pears and apples, with their warm, nutritious

juice. At last, when autumn already veils the sun in cold mists, and cuts off its warmth from us by dark clouds, the grape gives us, in its fermented juice, the most powerful cordial. Winter brings oily and farinaceous nuts, almonds and olives, which keep long and warm well. Still it must not be forgotten that those fruits which are, so to speak, necessaries of life, the wheat of the north, and the date, cocoanut and bread-fruit of the south, are constantly found in all stages of development, and last longer than a short season.

But fruits do more; they actually tell us when they are ripe and wish to be gathered. They mostly change their color for this purpose: as long as they are unripe, they are green like the leaves, among which they are concealed, or reddish like the bark to which they closely adhere, as is the case with plums. When they approach maturity, they assume brighter colors, so that the very change announces them to be ripe, and their rich red, blue, yellow, or black, invites those for whose use they were intended. Others appeal to us by their smell—and some even to our ear. The chestnut-burr snaps in the keen air, when the silent groves are already clad in autumn's garb; acorns and beechnuts are heard to fall in the clear atmosphere, and the ripe cocoanut strikes the ground with such force that the sound is heard for many miles. Other fruits of palms, which, until ripe, were hid under the protecting screen of broad leaves, burst with a noise like a pistol shot, a signal at which more than one guest is seen to hurry up to the rich treat. Among the latter none are perhaps more curious than the land-crabs

of the West Indies. They are exceedingly fond of these nuts, and yet it is vain for them to look up to a height which even man can but rarely reach; so the tree itself rings the dinner-bell when all is ready, and as night falls the hungry gourmands are seen to rush in armies to the feast to which they have been so quaintly invited.

After the fruit has ripened and the seed has been sent adrift, comes mostly the "last scene of all, that ends this strange, eventful history." For plants also die, and when they have bloomed and given seed, they droop and hide themselves in the ground, to rise once more and ever again with the coming spring. "The grass withereth and the flower fadeth," now under a burning sun, and now for want of moisture; excessive cold kills even the proud oak and glorious elms; the action of poisons or the ravages of an insignificant beetle make an end to their lives, but they die—happy plants!—without pain, without consciousness, still and silent as they have lived. Their time of life varies greatly, from the athletic oak, that stands the storms of a thousand years, a monument of nations, to the humble mushroom under its shade, which rises in a night, to perish in the morning. But the season comes for all, when the wind passes over them, and they are gone, and the place thereof knows them no more. And the vine is dried up, and the fig-tree languisheth, the pomegranate, the palm-tree, also, and the apple-tree, even all the trees of the field are withered. But how sweet is here even the parting, how full of comfort for the present, how full of hope for the future! The dying breath of fading flowers is their sweetest perfume, and a deep flush often overspreads

their rich crowns, before they fall. Even the leaves, when they shrink and tremble in the autumn breeze, are full of unwonted sweetness. And what can equal the oft described glory of fall, when the grasses take their humble russet garb, and the maple wears its "gorgeous crimson robe like an Oriental monarch." For leaves also change —some only as the ermine whitening in the cold season, or as birds who change their plumage in winter; such are the evergreens; others change to live no more; as man does, before he also returns, dust to dust. Their bright green grows pale, their vigor declines, their delicate tracery, that had so often induced us to marvel and worship the hand that made them, is effaced, and no longer serves to pass the life-blood of the tree. Then they shrink and shrivel, they flutter awhile anxiously on their feeble leaf-stalks, as if reluctant to leave their sweet summer home, and then comes the rude boisterous gale, and tears them for ever from the parent tree. "The bare skeleton of the tree becomes transparent, rising in spectral grandeur, as it stretches, full of woe, its bare branches against the cold evening sky, and rattles in the fierce tempest. A new, ghastly light is shining through its stripped anatomy. And it is a light, as with man—the same light of heaven, which in the waning lustre of life makes his spirit become lovelier every hour, giving him a sublimer faith, a brighter hope, a kindlier sympathy, a gentler resignation. Like the autumn leaf, he also glows into decay, and kindles into death. The sun of another world, already risen upon his soul, though human eyes cannot behold it, burns through the delicate texture of his thoughts, feelings and desires,

and shines, already here on earth, in all the radiancy of truth, hope, and peace."

Varied, therefore, as the appointed time of plants is, it has its fixed, irrevocable term. Not all leaves fall at the same time. The pine-tree keeps its leaves two or four years; the fir and spruce change only every ten years; some trees drop annually certain branches. The dead foliage of some oaks clings to them, long after all others have been swept away, and the young elm waits all winter, and drops not a leaf until its successor pushes it out of its resting-place. Some fall to form a soft litter beneath; others remain to afford shelter in bleak winter. But no art of man can arrest the falling leaf when its day has come. Artificial heat, removal to a warmer climate, and great care, may succeed in bringing out new crops almost without pause—but the process exhausts the ill-used plant, and it dies a premature death. Still even the decayed leaf is not lost. It enriches the soil, and fall produces spring, the dying leaves helping to bring forth the bright verdure of the coming year. Thus the great circle of life goes on without interruption. The general signal for the shedding of leaves is the maturity of the seed; that greatest purpose of the life of plants once accomplished, they die, or at least, rest for a season. Thus death comes to some after a few days; bushes and low trees keep their seeds during the winter, welcome food for starving birds; and the humble chickweed brings forth seed seven or eight times a year, not resting even during winter, and keeps open table for many a tiny wren

or hungry sparrow; showing us once more Providence so much greater, as its creature is feebler.

This kind of decay excepted, plants, it is thought, are not subject to the destructive operation of internal causes; vegetable life succumbs to outward influences only. The vitality of trees is certainly almost incredible. No kind of mutilation can, apparently, destroy them. Who has not seen old willow trees, adhering but with a small portion of the bark to their roots, and yet continuing to live and to perform their duty? How beautifully does not the chestnut of our own noble forests send out a crown of young shoots to hide the vacant space where once it reared its mighty stem? The whole vitality of the inner wood may, in fact, be destroyed; if only some layers of the bark survive, the tree will vegetate with undiminished vigor, and continue its life for an almost unlimited period. They will, in very old age, lose some of their height by decay at the top, for it seems as if the sap could no longer ascend the whole lengthy road from the deeply buried roots to the lofty crown, but they continue still to increase in girth, and patiently wait for the stroke of the axe or the fierce rage of the tempest. Thus it is that England boasts of many a yew or an oak tree, which has survived the massive church, by the side of which it was planted, and which yet, spring after spring, shelters the ruins of its once so proud companion, with its dark, refreshing verdure. The tender leaf even resists in its fragile texture, the winds and rains, the burning sun, and the nipping cold of a whole season. Greek and Roman sepulchres, stately palaces and lofty monuments over

the graves of the great and the renowned, have disappeared; nothing is left to mark the place where they once stood, but the dark cypresses that saw them rise, and since have overshadowed them for ages.

But even after death, plants live on, as it were, and are useful to man. Vast tracts of heath, covering large, low basins, and formed by the annual accumulation of vegetable matter, which in water becomes to a certain degree decomposed or carbonized, finally produce those blackened remains of plants which we call peat.

Or extensive forests, covering valleys, and hillsides, are overflooded, and the uprooted trees form a gigantic barrier, which prevents the flowing off of the waters. An extensive marsh is formed, particularly well adapted for the growth of various kinds of mosses. As they perish they are succeeded by others, and so for generations in unceasing life and labor, until, in the course of time, the bottom, under the influence of decay and the pressure from above, becomes turf. Far below lies hard coal; the upper part is light and spongy. At various depths, but sometimes as much as twenty feet below the surface, an abundance of bogwood is found, consisting mostly of oak, hard and black as ebony, or of the rich chocolate colored wood of the yew. Such ancient forests every now and then rise in awe-inspiring majesty from their grave. The whole city of Hamburg, its harbor, and broad tracts of land around it, rest upon a sunken forest, which is now buried at an immense depth below the surface. It contains mostly limes and oaks, but must also have abounded with hazel-woods, for thousands of hazel-nuts are

brought to light by every excavation, not exactly made for nuts. Our own city of New Orleans, it has been recently discovered, is built upon the most magnificent foundation on which city ever rose. It was the boast of Venice, that her marble palaces rested in the waters of the Adriatic on piles of costly wood, which now serve to pay the debts of her degenerate sons, but our Venice has not less than three tiers of gigantic trees beneath it. They all stand upright, one upon another, with their roots spread out as they grew, and the great Sir Charles Lyell expresses his belief that it must have taken at least eighteen hundred years to fill up the chasm, since one tier had to rot away to a level with the bottom of the swamp before the upper tier could grow upon it.

But there is still another vegetable world buried beneath our feet. For the trees of so-called primeval forests belonging to a period of hoary antiquity and far surpassing in exuberance the rankest tropical jungles of our day, have not, like modern woods, undergone decay, but are treasured up in subterranean houses. There they were transformed into vast enduring beds of coal, which in these latter ages has become to man the source of light, of heat, and wealth. Almost all of these trees are gigantic fern-trees, such as the world of our day knows no more; a few are so-called club-mosses of equally vast dimensions. Leaves and twigs rest closely one upon another, but often entire stems are found standing upright, forty to fifty feet high, with all their roots and branches, dread memorials of times beyond the memory of man.

Thus we may trace the biography of plants through

their often brief but always eventful life, from the first appearance of a small microscopic cell to their last burying-place under our feet, through all the glories and delicacies of vegetable life, beginning with the softened and decayed germ, and ending with the fossil coal. We see that each plant has a life of its own, that there dwells still in each tree a Dryad who watches over it and determines its growth, or sighs her last when it dies. We observe the beautiful harmony that exists between all their parts and the world that surrounds them. How the roots fasten themselves to the earth on which they grow, while the stem plays with every breath of air that comes we know not whence. The leaves breathe the water of rivers and of the atmosphere, the sun unfolds bud and flower, and the seed at last connects the plant once more with its future home, an eloquent witness of our own blessed immortality. But there is no monument set by their grave to tell us how they lived and what they achieved. Yet, they had their duties to perform, and faithfully have they done them. Well may we, then, in conclusion, ask—For what purpose does the plant spring up, the soil feed and nourish it, and the blessed sun mature its seed?

Plants satisfy the common necessities of man and beast. They nourish man's body in health, they restore him in sickness; they give him the clothing that covers him, the varied hues that delight his eye, and the odors which refresh his senses; the timber of which his houses, his factories, and his ships, are partly or wholly constructed—all these are but a few of the many benefits which the veget-

able world confers upon man. Wherever we look, we see in it our great resource; even our railroads and our mines could not exist, were we not masters of forests. We would succumb to the cold of winter, food that becomes nutritious only by the aid of fire, would be useless, the power of steam would not carry us from land to land and over the broad ocean, if we had no trees. The very destruction of plants is made necessary for their existence, for the wisdom and forethought of the Creator is in this also manifest, that, whilst plants invest and ornament the earth, animals browse and trim them to check their luxuriance, so as to maintain the whole system of creation in order and beauty. And yet this is but the humblest purpose that plants serve on earth—the humblest because it only satisfies material requirements, however we ourselves may have refined and varnished them over. Only in one point of view does this important end of their existence obtain a higher value:

It is true, plants are there for man, for the countless poor, and God said: In the sweat of thy face shalt thou eat bread; thou shalt eat the herb of the field. But the very curse of the Almighty has since been turned into a blessing. If man does labor in the sweat of his brow, to eat the herb of the field—how abundantly is he rewarded! Of a mere thorn he has made, as if by enchantment, the beautiful and fragrant rose. Before he thus labored, the olive was dry and offensive, the peach bitter, the pear had but a hard, woody flesh, and the apple-tree was full of thorns. Man labored and the thorns fell, the rose doubled and trebled its brilliant crown, the peach

and the pear filled with perfumed juice, the olive lost its bitterness, and the wild grasses were converted into waving fields of life-sustaining grain. The influence which the vegetable world thus exercises on the civilization of man, is as yet but little noticed; only in the great outline has it been observed, that wherever the spontaneous productions of the earth supply him with food, he is completely savage—only a degree farther advanced where he plants the palm and the banana—but where grain is his principal support, as in the temperate zone, industry and intelligence are most perfectly developed. We are thus taught, that the rich heir is not the happiest, but that the child of the poor man, gifted with industry and indomitable will, has far more power over prosperity.

Modern science has revealed to us, of late, a higher duty and a nobler purpose in the life of plants. Working in masses they regulate the numerous and comprehensive physical processes of the earth. Theirs is the duty to keep the atmosphere dry or moist, as may be required. On them depends the warmth or the coldness and the fertility of our soil; they alter the climate, change the course of local winds, increase or diminish the quantity of rain, and soften the rigor of the seasons. It is not merely that whole countries and regions look to certain plants for their sole support, or that the life of entire nations is bound up with that of a single tree, like the Mauritius palm, but whole races of men, through numberless generations, can live only where it pleases, under Providence, certain plants to grow and to prosper.

By far the noblest and most exalted purpose for which

plants live is, however, to adorn the surface of our beautiful earth, and thus to make manifest to us, in their very existence, and in all their thousand wonders, the Almighty Creator of heaven and earth. It is in this aspect only that plants, the types of nature, acquire their highest significance. They become then, not our friends and supporters only, but our kindly teachers also. Whether we look down upon soft mosses that creep over the rugged rock, and humble lichens weeping with slow oozing, or gaze up at the giant tree of the forest, every where our mind is lifted up, in awe and wonder, to that Intelligence which watches over the destinies of the universe, and gives us here already a faint glimpse of the great plan of creation and its great author.

Clearly, however, as we all feel the impressions which the vegetable world, and especially the consciousness of their still, unceasing life and labor produces upon our mind, it is extremely difficult to explain the causes, or even to determine and express them in words, clearly and distinctly. The mere farmer, it is true, sees nothing but tons of hay in a flowery meadow, and so many bushels of wheat in a glorious field of golden grain—the majestic forests represent to him but so many cords of wood, and the broad branched elm, in all its lovely beauty, shades his land, and is a nuisance. On the other hand, we know that it is not the refined mind and the most fastidious taste that enjoy the beauties of the vegetable world most and best. The humble men of St. Kilda, we are told, who went to pay their duty to their lord in the "far southern" island of Skye, could hardly proceed on their

journey, because "the trees—such beautiful things they had never seen even in their dreams—the trees kept pulling them back." It is, moreover, evidently not the mere mass of foliage, nor the depth and variety of color, that affects our senses, but the almost imperceptible and unconscious effect of all these elements together on our soul. The rose does not please us merely because of its tender glow and delicate hue, but because our imagination connects with it the idea of blooming youth, and a thousand other images float around this. The landscape, with its various parts and beauties, acts upon man, upon his tone of mind, and thus imperceptibly upon his entire inward development. How different must needs be the idea of the world to him who obtained his first impressions from the solemn, evergreen pine woods of the north, overshadowing deep blue lakes and vast granite-strewn plains; and to the happier man, whose early days passed under the bright leaf of the myrtle and the fragrant laurel, reflecting the serene sky of the south! Even in the same land, how differently is the mind affected by the dark shade of a beech-wood, the strange sight of a few scattered pines on a lonely hill, sighing sadly in the fitful gusts of wind, or of broad, green pasture-lands, where the breeze rustles gently through the trembling foliage of birches! Our hearts beat gladly and joyously when fields of flowers are lighted up in bright sunshine; our spirits droop when we see them look sad and forlorn on a rainy, melancholy day. Peace and quiet happiness teach their gentle lessons to him who dwells in fertile valleys, with velvet lawns on their bottom, and the sides tufted with

the ash, the cheerful beech or the feathery juniper, shaded, it may be, by the soft dark verdure of ancient yew-trees, whose venerable trunks were slender saplings in the age when Druids worshipped there. Men live not so on the boundless prairie, where the wolf chases the swift crane, where cloud races after cloud, and the white man wages war against the red man. Free and bold, beyond all others, breathes the mountaineer, bred in the fierce, incessant warfare with the rigor of Alpine winters and the dangers of the chamois hunt; defying all earthly power, he looks down from his lofty home, proud that liberty dwells on mountain-heights, and that the foul breath of the grave does not reach up into the clear blue ether around him.

The effect is as varied when we take not the whole vast scenery of a landscape, but its more isolated parts. Few will look upon the ineffable beauty and sweetness of flowers, that rich jewelry with which heaven has adorned the bosom of our mother earth, without feelings of elevating and refining delight. To him who observes, not with his eyes only, but with his mind intent, his heart alive, there is no resisting their unconscious unfolding, their peaceful, childlike life, their gentle, resigned and hopeful drooping. Who has not in his life also some days of gay and sunny spring, when he loved to look upon flowers as dear to him, full of hope and love, when he felt for them and with them, as they would ever look fondly upward to the clear, blue heaven above, smiling on the sun that cheered them, rising lightly from refreshing rain, never folding up their beauty and sweet fragrance,

save to give it forth again as day would once more brightly rise. Oh, well has it been said that each cup of a flower is a pulpit, and each leaf a book from which we may learn the wisdom, goodness and power of Him who has so lavishly scattered his handiwork over the face of the earth. Few, also, can look up to a stately tree, reared in its colossal leafy grandeur, its head in the clouds, its roots in the firm earth, so full of life and vigor, without feeling himself lifted up with its gigantic branches to higher thoughts and purer feelings. We all can feel with the exiled Syrian, who went to the Jardin des Plantes and there "clasped his country's tree and wept." And as the scalding tears trickled down the rugged cheek, he was once more a wanderer in the desert, and once more he breathed, across the dreary sand, the perfume from the thicket bordering on his promised land; again he saw, afar off, the palm-tree, cresting over the lonely, still waters, and heard the pleasant tinkle of the distant camel's bell—until his tears were dried, hope again revived, and fresh and glad emotions rose within his swelling breast. Oh, there are wondrous lessons in plants! Eloquently quotes a modern writer thus of the words that trees speak to us: "Do not trees talk with their leafy lungs? Do they not at sunrise, when the wind is low and the birds are carolling their songs, play sweet music? Who has ever heard the soft whisper of young leaves in spring, on a sunny morning, that did not feel as if rainbow beams of gladness were running through his heart? and then, when the morning glory, like a nun before God's holy altar, discloses her beauteous face and the moss-roses open

their crimson lips, sparkling with nectar that fell from heaven, who does not bless his Maker?—and when autumn comes, the season of the sere and yellow leaf, when wheat is in its golden prime, and the corn waves its silken tassels in the charmed air, who is not reminded of the reaper death?"

As every season has its own tone and lesson, so every flora and every variety has its peculiar echo in the heart of man. Harmonizing, like music, with all the various trains of thought and images of fancy, with every conceivable state of mind, plants and groups of plants ever awaken kindred feelings. There is a mysterious affinity between human consciousness and outward nature, but still more mysterious is the varied manner in which this relation is modified by individual feeling. The waving cornfield has its beauties, and so have long avenues of poplars, with vines hanging in rich festoons from tree to tree. Plains covered with orange groves and chequered with fertile slopes and vineyards, dense forests of gigantic and primeval growth swarming with every variety of animal and vegetable life, these and countless other scenes find each its response in some train of human emotions and affections, which, like the lyre of Timotheus, they by turns excite and soothe. Each tree that we know has its own expression; it has witnessed our joy or our grief, and wherever it meets our eye, it seems to murmur responses. So it is with larger groups. Here we see vast prairies with gently waving floods of verdure, full of grace and cheerfulness, there long sombre porticoes of gnarled old stems, standing, as the cedars of Lebanon, massive pillars,

supporting their ponderous domes. Beautiful roses, with their short-lived flowers and hidden but permanent thorns, remind us of earthly pleasures—a forest, with its silent temple of foliage, raised through centuries on gigantic trunks, high above man and full of peace and majesty, fills us with religious awe, and makes us bow low and reverently before these visible tokens of the Creator's sublime power. Even the humblest of flowers bring with their sweet perfume rich blessings to the heart of him whose hand tends them with care. Where a flower opens its quiet, child-like eyes upon us, our passions fly like evil spirits, and he who delights in the still, humble growth of delicate plants, is not apt to harbor coarse thoughts or fierce feelings. In the house around which we see a tidy, well-kept garden, order and peace are apt to prevail, and where there is a flower-stand outside, there is almost always a book-shelf within.

In his joy and in his sorrow, therefore, man loves to surround himself with plants and flowers. He crowns the bride with sweet myrtle or the pure orange blossom; the laurel speaks to him of glory and renown, the palm-branch of glorious hopes for the future. And when the loved one departs, he turns again to the flowers of the earth and the trees of the forest, that they may grieve with him and give expression to his sorrow. From the South Sea to the icy north, from east to west, grief finds the same simple but touching expression. The mourning peasant of Normandy burns the lowly straw bed, on which his friend expired, before his hut, and the round black spot, as it contrasts with the green turf by its side, re-

mains long an humble but eloquent epitaph of him who left no other record behind. In peaceful villages we see neither gorgeous monuments, nor lofty trees rising in honor of the dead—and, we fear, as frequently in praise of the living—but, sweeter far, the graves are covered with green sod or humble flowers. "We adorn graves," says gentle Evelyn, "with flowers and redolent plants, just emblems of the life of man, which has been compared in Holy Scripture to those fading beauties, whose roots being buried in dishonor, rise again in glory."

The Japanese deck with flowers their "eternal mansion," and the Turks perforate the monumental slabs spread on those who shall be seen no more, in order that a natural growth of bloom may spring up through the apertures, and that the buds, so nourished by the grave, and set free to the winds of heaven, may shed their fragrance and strew their petals around the "city of silence." The western traveller gazes with deep sympathy upon the grave of the Chinese; it is a simple, conical mound of earth, but over it spread and twine wild roses and cover it with a mass of pure white blossoms, or it is crowned, in simple majesty, with a tall tuft of waving grass. Our cities, also, now love to bury their dead where woods unfold their massive foliage and breathe an air of heaven; their better taste has made the green grove and the velvet lawn sacred to the memory of those that are gone to the realms of peace.

And what eloquent mourners are not trees! The dense cone of the cypress overshadows mournfully the Moslem's tomb, with its sculptured turban, and the terebinth keeps

watch by the Armenian's grave. Some nations love to weep with the weeping birch, that most beautiful of forest trees, the lady of the woods, with "boughs so pendulous and fair," or with the willow of Babylon, on whose branches the captive Israelites hung up their harps. They love to look upon their long, thin leaves and branches, as they hang languidly down to the ground, or trail listlessly on the dark waters, now waving full of sadness in the sighing breeze, and now floating in abandoned despair on the silent waves. Their whole dishevelled and disheartened aspect seems to deplore some great misfortune, and we can fancy poor Desdemona singing how

"The poor soul sat sighing by a sycamore tree,
Sing all a green willow,
Her hand on her bosom, her head on her knee,
The fresh streams ran by her and murmured her moans,
Her salt tears fell from her and softened the stones,
Sing all a green willow must be my garland,"

for Desdemona also had a song of a willow, and she died singing the song of the willow.

Other nations again love not trees that seem to unite in sorrow with the earth, and to carry our regrets to the dust, but rather cherish such as seem to lift up our hearts in their branches, and to raise our hopes to heaven. Such are the mountain cypress, the lofty poplar and the sombre pine of the north. The latter, especially, with their dark but evergreen foliage, their balsamic fragrance, the strange sad sighs that are ever heard in their long boughs, and their lofty crowns, reaching to the very clouds, which suc-

cessive seasons find unchanged and nothing but death causes to vary, remind us of the only source from whence comfort comes for our wounded hearts, and lift up our eye and our heart to that God who gives death and gives life again to those that fear him.

VII.

Plant-Mummies.

"He spoke of beauty: that the dull
Saw no divinity in grass,
Life in dead stone, or spirit in the air."

TENNYSON.

THE Psalmist says:—"Thou madest man to have dominion over the works of thy hand; thou hast put all things under his feet." And truly, man is the master of the world.

There comes a joyous breeze in freedom through the air, and sings its merry songs in rush and reed, or plays sportively with branch and briar. But see, man stands upon the breezy hill, and catches the light-footed wanderer above; he stops him on his fruitless errand and makes him a servant, a slave. The wind can no longer roam at will over hill and dale; he must turn, in restless haste, the huge wings of a mill, or he is bound in towering sails, and has to drive mighty ships through the impeding waves.

There rushes a bright, cheerful spring from its cold mountain home down into the plain, and as it leaps over rock and root, it dashes its snow-white foam into the dazzling sunshine, and raises its little anthem of thanks and praise at every fall, in every valley. But here, also, the master stands in its way and compels it, a child yet, to turn the mill-wheel; or he loads the well-grown river with heavily-laden barges, that it must carry from land to land to the mighty ocean.

The fish of the sea, the fowl of the air, and every living thing that moveth upon the earth, the trees and the herbs, the stones and the metals—they are all slaves and serfs of man. Even the lowest, made in the image of God, is still master of all the powers of Nature. The South Sea islander makes plants support him, and beasts serve him; they build his hut on land, and carry him in boats over the seas. Savage and inhospitable winter fashions the water into clear blocks of ice to build the Esquimaux' house; the seal furnishes oil for his lamp, the whale gives him ribs for his boat, and heads for his arrows.

But it is not the strong arm and the skilful hand of man that makes him thus master of Creation. His mind is the ruler of the world, the true Lord of Nature. It makes the sea and the mountain his slaves, so that the ice of the pole, and the heat of the tropics must serve him as he wills. And when he has mastered all that eye can see, and hand can grasp, when the present has nothing more to give him, and the future seems to elude his grasp, he descends into the past, and raises even the spirits of the departed to serve him.

Man had exhausted the resources which the vegetable world of our day afforded him; every herb bearing seed, and every tree in which is the fruit of a tree, had been to him for meat. But he desired more, and his restless, insatiable mind longed for new realms and new powers. So he went back into distant ages and exhumed the bodies of ancient generations. For animals and plants both, are made faithfully to return, to their common mother earth, whatever they have taken from her. The beast of the field, and even proud man die, and dust returns to dust. Plants, also, the first-born children of the earth, must die, and return to the bosom of their great mother. But they sink only to rise again, or if buried beneath the ruins of ages, they preserve, even there, in eternal night, a breath of their former vitality, and centuries after, their dead bodies become, in the hands of man, once more a source of light and life.

From the western coast of France, vast desert plains stretch far east, through northern Germany and Russia, until they are lost in distant and unknown Siberia. The traveller shudders, he knows not why, as the boundless expanse first strikes his eye. There is no fresh waving tree to whisper words of good cheer and pleasant welcome; there is not a hill, "which God delighted to dwell in." All is level, covered with brownish-red heather, with the golden blossom of the broom and thorny juniper-bushes. Only now and then a green marsh relieves the oppressive monotony, and grazing herds of cattle give life to the scene; but soon again the desolate moor spreads far beyond the horizon in dark, dreary dullness. The air hangs

in gloom over the lifeless swamp; even the moor fowl cries as in agony, and the swift swallow, chasing light-winged dragon-flies over the rushes, twitters in an undertone, and utters mournful complaints. Poverty alone dwells on the borders of these desolate plains; low huts scarcely venture to raise their turf-roofs a few feet above the ground, and the dwellers on marsh and moor show in their pale, downcast features, that the clear air of heaven but rarely greets them, and that the pure water of highland springs is a luxury unknown.

Yet, these moors are a world of their own, peopled by races of beings, found nowhere else, and furnished with plants unknown to other lands. They have their history as well as the lofty mountain and the rich valley; they are born, they grow and prosper, they decay and vanish.

On many a plain, on lofty table-lands, or close to the ocean's restless pulse, wherever water gathers, from a thousand invisible sources, little pools and miniature lakes are formed, which the clayey ground or solid rock beneath prevents from reaching their great home in the sea. Upon these waters little tiny plants appear, hardly visible confervæ; they come, man knows not whence, but they multiply in amazing haste and soon cover the stagnant pool with living green. Of a sudden, however, they are gone; they have sunk down to the bottom. There they form layer upon layer; slowly, indeed, for the naked eye measures them only by hundreds of generations; but as particles of sand and stone gather in their hidden folds, and as the bodies and shells of countless minute animals, who found a home in the waters above, are buried amidst

them, they rise year after year. Gradually they afford a footing and food for numerous water-worts, in whose mouldering remains mosses and rushes begin to settle. These bind their roots firmly, they join hand in hand, and arm in arm, until at last they form a soft green cover of peaty mould, far and near, over the dark, mysterious waters.

The older the moor, the firmer and stronger is, of course, this turf cover over the brownish pool, that gives out a faint but piercing fragrance. Near the sea-shore, and in rainy regions, larger quantities of water frequently remain between the firm ground and the felt-like cover, so that the surface breathes and heaves like the waves of the great ocean. In drier countries, heath, hair-grass, and even bilberry bushes grow in the treacherous mould. But the moisture beneath gnaws constantly at their roots, so that they die off, whilst the herb above clings pertinaciously to life, and sends out ever-new shoots—a faint, false semblance of life, like the turf on the moor itself, in its restless, unstable suspension above the dark-brown water beneath.

This turf-cover, consisting of countless partly decayed plants and their closely interwoven roots, is our peat; those vegetable masses that have accumulated at the bottom of the moor are bog-earth, and below them, as the oldest layer of all, lies the so-called black peat. As early, even, as the thirteenth century, these remnants of minute mosses were used as fuel; but it was not until the sixteenth century that the Dutch especially, who know no other kind of fuel, devised a systematic mode of making these treasures permanently available. Now, the upper turf

is, during the dry season, cut out into large square pieces, that serve mainly to cover the lowly huts, which the dwellers in those regions bury half under ground, and then raise a few feet by loosely arranged stones. There they live, the most miserable of men upon earth, dark gloom all around them, and deeper gloom yet within their cheerless, unlighted hovels.

If the moor is deeper, ditches are dug to carry off the dismal water, and then the lower peat is carried away in large pieces to serve as fuel. Often, when it is too moist, it has to be kneaded, pressed into form, and then carefully to be arranged in large, well-aired sheds, to dry and to settle. If water be allowed to stand on the excavated moor, the peat is renewed in a few years, and may be cut again, though the period varies from twenty to two hundred years in different portions of Europe.

Vast regions of our globe are covered with these remnants of once bright, blooming flowers. The table-lands of the Cordilleras in South America, the boundless plains of Siberia, one-tenth of all Ireland, a large portion of Germany, part of Scotland, Jutland, and Norway—even the sides and valleys of the Alps abound with such moors. The polar circles are not free from them; there, also, mosses and algæ still grow, and so closely and thickly that they form, as it were, but one great mass of woody fibre. Their growth is peculiar; they add every year new shoots to the upper extremities, whilst the lower as constantly die and change, when dry, into rich humus, but, when kept moist, into peat. Thus the famous Tundra, the giant-morass of Siberia, is an almost inexhaustible

storehouse of this most valuable material. In our own United States, it is well known, swamps of enormous extent abound in the south, overgrown mostly with cypresses, and containing large peat-bogs, into which man can only venture at the peril of his life.

Almost inaccessible in days of yore, haunted by ghastly spectres, and illumined only by the treacherous light of will-o'the-wisps, these dreary but valuable regions are now cut through by railways and canals. For miles and miles the traveller in Europe passes through the midst of countless gigantic heaps of peat. Here and there, miserable huts are half hidden; stunted, squalid children, play around them in dogged silence; in the distance a cross, formed of white birch poles, rises high in the air, and before it, lies prostrate their mother, buried in anxious prayer. Beyond it, you see long rows of laborers, strong, swarthy men, breast high in the swamp, digging with eager haste, whilst others carry huge masses, well-balanced on their heads, to the drying-house.

Here, also, the power of the small in the great household of Nature is strikingly illustrated. Tiny confervæ and barely-visible swamp-mosses form vast moors, the fuel of nations, giving bread to thousands, regions full of wonders and mysterious charms. A diminutive water-lentil (Lenna trisulca) is the main laborer in this unknown and unseen process. With its little, dark-green leaves, it lives entirely under water; only when about to blossom, it rises for awhile into the air, and then sinks forever to the bottom, there to be changed into peat. It forms closely-woven, thick layers, filled with sand and snails, and even

trees. When confervæ alone are at work, the peat lies in the shape of thin, paper-like leaves, as if year after year a new generation had lain down to rest on the corpses of the preceding season. Small streams of water, flowing under ground, complete the decay of the vegetable matter, and consolidate the whole, till it becomes blended in one confused mass.

Dark and dismal the green turf stretches far away, as far as eye can reach. It knows neither spring nor summer. Below is the dark, unfathomed abyss. Here and there fierce gusts of wind, or strange powers from below, have torn the gloomy shroud asunder, and the dark, black waters stare at you, like the despairing eye of the dying sinner. Even the bright sun of heaven cannot light up the haunted mirror—its golden face looks pale and leaden. No fish swims in the inhospitable water; no boat passes swiftly from shore to shore. Whatever has life and dreads death, flees the treacherous moor. Woe to the unfortunate man who misses the narrow path! A single step amiss, and he sinks into the gulf; the green turf closes over him and drowns the gurgling of the waters and the anxious cry of the victim.

Far, far down in the depths of the moor there lies many a secret of olden times. Below the grim, ghastly surface, below the waters, below the black remnants of countless plants, lie the sad memorials of ages unknown to the history of man. Huge trees stand upright, and their gigantic roots rest upon the crowns of still older forest-giants! In the inverted oaks of Murten Moor, in Switzerland, many see the famous oak-woods that Charle-

magne caused to be cut down, now, more than a thousand years ago. For centuries the moors have hid in their silent bosom the gigantic works of ancient Rome, and posterity has gazed with awe and wonder at the masterly roads and massive bridges, like those built of perishable wood by Germanicus when he passed from Holland into the valley of the Weser. Far, in the deep, lie buried the stone hatchets and flint arrow-heads of Frisians and Cheruski, by the side of the copper kettle and the iron helmet of the Roman soldier. A Phœnician skiff was found of late, and alongside of it a boat laden with bricks. The skeletons of antediluvian animals rest there peaceably by the corpses of ancient races with sandals on their feet and the skins of animals around their naked bodies. Hundreds of brave English horsemen, who sought an honorable death in the battle of Solway, were swallowed up, horse and men, by the insatiable moor. And in years bygone, a Danish King Harold, called the Blue Tooth, allured with foul treachery a fair princess of Norway, Gunhilde, to Jutland. She came, and she vanished from the memory of man. History had forgotten her, tradition even began to fade; but a peat-bog opened its long-closed lips, and accused, late but loud, the bloody king of his wicked deed. The poor princess was found, far below the peat, strangled and tied to a post, where her merciless foe had buried her, as he thought, forever, in the abyss.

It is a strange and most melancholy charm which these low chambers of death have for the careful observer. Where once gigantic animals dwelt, and tropical plants flourished in splendor, where broad roads passed through

the land, or forests stood in ancient pride; where trade and commerce prospered, and richly laden vessels sailed from port to port—there now the dead moor covers all life and spreads its dread winding-sheet alike over the deepest sea and the richest valley.

Even in our day, moors grasp with their death-hand at living nature around them. Here and there a lofty tree still rises from the dismal depth; in mountain valleys even groves and forests sometimes break the sad monotony. But in the unequal struggle the moor is sure to win the battle. Like foul disease, the hungry moor-water gnaws at the roots of noble trees. It softens the ground, it changes it into morass, and the proud giants of the forest fall one by one, before the dark, invisible foe beneath them. They resist long and bravely; but their roots are drowned with the abominable liquid, their hold is loosened, their leaves turn yellow and crisp; the wintry storm comes in fury, and the noble trees sink powerless into the grave at their feet. The struggle may be marked, even now, in all its stages. Thus, in the famous Black Forest of Germany, there rise on many a breezy hill glorious old fir-trees and graceful, silvery birches. Only a few yards beyond, however, the eye meets but with sorry, stunted dwarfs, trees crippled before they reached their height, old before their time, and weak already, in the days of their youth. Their crowns are withered, their branches hung with weird, weeping mosses. Then the trees become still fewer and smaller; low, deformed trunks, with twisted branches alone survive. At last, these also disappear, and the dead quiet of the moor, with its humble

heath, broken only here and there by a dying bush, or a lowly hillock, reigns alone and triumphant.

Even the sea has its moors and its bogs. When the tide recedes from the coasts of France and England, vast hidden morasses become visible. For miles and miles they stretch into the sea, these wide oceanic meadows. Engulfed plains, sunken marshes, where thousands of years ago a joyous world lived and loved, are now the home of fishes and muscles. Often a tempest brings large tracts of this watery peat to the shore, or a fisherman drags huge pieces of bog from the deep.

Stranger still is it, when the air enclosed in the fine, firm texture of matted roots and fibres, buoys a bog and raises it high up into the air. Then large pieces are torn from their ancient resting places, and are carried about like floating islands, at the mercy of winds, until the waves rend them into fragments, or the water they imbibe makes them too heavy, so that they sink once more down to their proper home. Such islands of peat have been found large enough to afford pasture for a hundred head of cattle; but a few years destroy their form, and they disappear without leaving a trace behind them. Near St. Omer, in France, these islands are left to roam freely, during summer wherever they list, but in winter they are tied fast to the shore. Still others bear trees, even on their surface; and both Russia and Chili have such strange vagrants, formed of sea-grass, even in clear, transparent water.

Rarely only, the moor despises the slow progress of undermining and silently engulfing living nature, and breaks,

in wild fury, through its long quiet. The putrefying waters and the fermenting masses of decayed vegetation, beneath the closely woven turf, develop gases which then raise the plain into hills and change the whole aspect of the landscape. When this force is very great, or when rocks and masses of earth impede its convulsive movement, the swollen bog suddenly opens with hoarse thunder, and a black torrent of foul, hideous mire pours forth with overwhelming violence. Thus it happened in 1821, at Tullamore, Ireland, when a huge bog, several acres in extent, broke loose, and travelled for nine miles, over a broken country. It laid waste everything it met with in its course. Houses were levelled with the ground at its touch; trees torn up by the roots; the fields were covered and the valleys filled with bog. Thousands of men were summoned to arrest its destructive march; dams were built, and walls were erected, but all in vain. The torrent rested not in its fatal course, until its fury was exhausted, and silence once more brooded on the black moor.

Far in the deepest deep of our mother earth lie still older mummies of plants, that flourished and withered long before the gates of heaven were opened and God's bow was set in the cloud. They date back to the mysterious days when the hardly formed globe, still incandescent, was but loosely held together by a thin crust of primary rocks. Below them the pent up fires of the vasty deep glowed and raged in untamed fury; above them hung a hot, stifling air, and huge masses of heavily laden clouds. Rain, fierce, incessant rain, poured down upon the chaotic scene; here and there the slight cover burst, volcanoes rose, continents

greeted first the light of heaven, and islands sank, to be seen no more. All the powers of nature were unchained; the earth was one vast battle field, on which the elements fought for the empire of the world. It was in those hours of gigantic strife, and, amidst the thousand thunders of a quaking earth and a threatening heaven, that huge forests were buried in the bosom of the earth, to wait in patience for the day of their resurrection.

Upon the first islands that rose out of the gurgling, struggling waters, when land and water were parted by the Most High, there grew forests of gigantic forms, of horse-tails and club-mosses, full of beauty and luxuriant vigor, but they bloomed and blossomed not. Sigillaria gently waved their lofty crowns on their slender curiously marked trunks. In the pride of their grandeur, rising high above the lowly bushes around them, they ranged themselves in copses and forests. Parasite ferns fluttered in the restless winds, like green pennants, from column-shaped, gigantic canes, whilst gentler breezes whispered sweet secrets to the graceful rushes along the banks of interminable marshes, and stigmarias painted the quiet surface of peaceful inlets, with the beauteous image of their graceful foliage. Algæ and mosses grew in pleasing forms on rock and stone, and struck their tiny roots deep into cleft and fissure.

Where now Spitzbergen and Greenland, Melville and Bear Islands rise in the splendor of eternal snow and ice, tall grasses were then rocking and dreaming of the wondrous time that would come when Man should be born after the image of God. Trees, high and strong, bushes

of strange, fantastic shapes, unbounded forests of colossal reeds and flags, overshadowed the shores of the dark ocean, encircled with dense night, large, ever-silent marshes, and crowned in graceful groups the table-lands of these islands. But silence brooded over them all. As no flower ever graced their lofty columns, so no bird ever sang in their branches, no deer ever rested in peace under their shadow. The sea alone, the great sea, had its life. Here the huge, flat head of a monstrous lizard rose heavily from under the roots of a mighty fern; there a shark of unmeasured dimensions shot, like a flash of lightning, through the turbid flood; polypi, snails of quaint shape, and muscles resplendent in brightest colors, crowded the shallow estuaries. A thousand curious forms, no longer found upon earth, peopled the silent waters, and generation after generation passed away, unseen by man and unknown for countless ages to come.

They rose, they lived, and they died in utter silence and darkness. They returned dust to dust, or they sank into the bottomless ocean. Now the fury of fiery volcanoes would bury whole forests under masses of burning porphyry and basalt—then the sea itself would rise in solemn majesty, and, racing upwards, fall upon ancient woods, breaking down young and old, high and low, and leaving behind it but one vast mass of sand and stone, under which it had hid all their glorious beauty. Where neither fire nor water came, with giants' power, to destroy, the huge ferns died a slow and silent death. One by one they would sink, weary of life and worn out by the fierce storm all around them, until gentle rains came, and with

tender sympathy, spread a pall of white sand and bright colored stones over their buried bodies. A new race sprang up from the exuberant bosom of nature; it also was laid low, and buried under massive rocks and green turf, and a new forest rose, phœnix like, from its ashes. And again and again the furious tempest swept along, and covered them with dense layers of sand, or heaped rocks over their grave, as if he would fain have silenced forever the revengeful whisper of antediluvian forests. There are places on earth, where one hundred and fifty of such successive generations may distinctly be counted!

But tenderly as nature had covered their dead bodies, still their race was not yet run, their purpose but half fulfilled. Tree by tree, and herb by herb, they lay peacefully in their grave. The storm sighed no longer in their branches, the upheaving earth shook not their lofty trunks. Warmly imbedded they slept in their quiet chambers. Thousands of years passed, and their rest was unbroken, their very existence unknown. No human eye had seen them in their prime; they had died and sunk into their grave long before man dwelt in the world. But now, after centuries, man came and made his way through vast layers of clay and firm strata of rock; he descended into the deep of the earth, to exhume the huge forests that had lain there buried since the days of creation. He brought them forth, the corpses of long forgotten plants, to the light of a sun they had never seen before; he made their remains to work for him—his busiest servants, his most efficient slaves. It was thus that the ruins of

the past became the masters of the present. These flowerless firstlings of creation were made to rule and control, at the bidding of the children of this day, wind and water, space and time. The light of earliest ages, safely buried in the bosom of our mother earth, was called to life once more, and made to shine bright and brilliant over land and sea.

In the lofty mountains of Peru, man found the black, shining mummies; far from under the ocean's bed, he brought to light the same mysterious plants, the same gigantic fern-trees. A new book was opened to him; the coal-fields of the earth became chronicles of ages unknown to history or tradition. Leaf after leaf was unfolded, and not a letter was found to be effaced. Whatever had had life upon land or in water, was carefully preserved, in image or substance, in the long hidden treasury. Not a plant was missing, not a leaf was wanting to rebuild the wondrous world of earliest ages. The dark night of deep mines unfolded an incredible richness and splendor of vegetable forms. As if with gorgeous tapestry, their walls and ceiling were found covered with graceful garlands of unknown creepers. The rich tracery of delicate leaves and tendrils is marked in deep black on the lighter surface of the surrounding rock. Lofty trees stand, as they stood countless ages ago, in all the luxury of their massive trunks, their wide spreading branches and beautiful foliage. Fossil trunks have been found, whose year-rings told of an age of more than eight centuries! Palms and tropical trees alternate with the pines and poplars of northern

regions; and there, too, sleeps the animal world of those days. Here is the big lizard, not one of her tiny scales wanting; there is the colossal shark, in all his huge dimensions. They are all there, every plant and every animal, uninjured by the unsparing tooth of time. Not a line is effaced, not a letter is illegible in this great book of nature.

Man soon determined to employ the new power thus granted him; but, although Marco Polo tells us that the Chinese used coals as far back as his own time (1270) Europe did not employ them until about a hundred years ago. Then, however, began the reign of the new agent in man's rule over the earth, and the strange spectacle is presented in some places, that the mummies of long-forgotten trees, reared in regions once tropical, but now ice-bound, must serve to warm the houses of men and to force tropical fruits in northern climates. Now, coal as fuel, drives the railway train and the steamer; it works in every factory, it burns on every hearth; it is to England more precious than gold and costly jewels.

Its gases, the terror of the poor miner who but too often falls a victim of the terrible "fire-damps," have been changed from a death-bringing enemy into a most useful servant. To drive them out from the mines, they were at first conveyed in tubes to the outer air. By accident it was found that they could ignite, and from this simple attempt to effect an escape for a nuisance, man derived the light which now rivals the noonday-brightness, and gives peace and security even to overgrown cities.

All this, and much more, we owe to the long buried mummies of plants that lived, we know not how many ages ago. Truly, we see, as yet, but "as if in a glass, darkly," and His wondrous works are hidden to our dim eyes.

VIII.

Unknown Tongues.

"All the earth shall sing unto Thee; they shall sing to Thy name."

IT was a dark and dismal night when the brave Almeida's ship stood off and on the coast of the fragrant island of Ceylon. With a stout heart and a bold hand he had sailed into seas unknown. Day after day, the smooth, glassy surface had shown him only his own vessel's graceful rigging and quietly rocking hulk, until famine began to shed pallor on the face of the bravest of his followers; and his own proud Portuguese soul felt terrors creeping over it, and despair even menaced life. So they prayed to their saints and their God, and He heard them. The waves curled in silvery crests, the huge sails hailed the coming breeze, and at last the sweetest of sweet sounds on the wide ocean, the gentle wash of the waters up the ship's bow, greeted the ear of the anxious mariner. At night dark mountains rose on the far horizon, and "Land!" shouted the exulting watch from the

mast-head. And, as dusky shadows covered the sea, fresh, sweet odors came from the distant island. Bright fires—oh, how welcome a sight!—were seen rising; and even the voices of men were heard in strange, unintelligible accents. But what was that voice, which, all of a sudden, swelled on the air, and like magic filled their minds with unutterable sorrow? Now it seemed to rise from the dark depth by their side, and now it came far and faint as from a distant world. At one moment, it broke in fierce, fearful cries, and then again it sank to such melancholy complaining that anguish seized on their souls, and tears trickled down their rugged and weather-beaten faces. They crossed themselves; they fell on their knees; and even their fearless leader implored the Lord on high, to spare their lives and to guard their souls against the power of Satan!

Often were those deep, mournful sounds heard in those distant waters, and many were the accounts that science and superstition gave of the fearful "Voice of the Devil." Or was it, as some fondly believed, even in our own age, the mysterious utterance of the Spirit of Nature, dwelling in our globe and in all the vast realms of creation? Later days brought other explanations. There were enormous gullies there, it was said, and narrow passes cut through the gigantic mountains, so that the rushing of winds and the roaring of waters, played on as an Æolian harp of colossal size.

Our day has, at last, torn the veil of superstition and fancy, and replaced a tale of impossible wonders by facts of even more marvellous beauty. There lives, near the shores of Ceylon, a large and most gorgeous shellfish. And when the

light of the moon rests dreaming on the bosom of the ocean, and gentle breezes, laden with fragrance, come cooling and calming from distant homes, it opens its bright-colored lips, and pours forth its mild, melancholy music, that the breakers on shore are heard no longer, and the heart of man is moved.

It was surely not said in vain, nor was it a mere figure of speech, when the Psalmist exclaimed: "All thy works praise thee, oh Lord!" For all creation unites in the vast hymn of praise that daily rises to His throne on high. The morning stars ever sing in the heavens, the mountains echo back the voice of thunders: the earthquake replies to the roar of the tempest; and even the tiny insect, in its mazy dance, adds a feeble note that is heard by Him.

Thus we have a thousand voices around us, sending up their great, never-ceasing anthem. But proud man has little heeded, heretofore, the countless accents of nature. Infant nations hear them and comprehend them not; the higher races listen to their own words only, and their ear is closed to the humbler voices around them. Thus they are truly Unknown Tongues. Quite recent researches, however, have thrown some faint light on this strange and attractive province of knowledge.

As the unfortunate child, that is born deaf, can neither hear the sweet voice of its mother, nor learn the mystery of language, so animals also cannot have speech unless they have hearing. For ages, all the lower tribes were curtly classed among dumb creation. Mollusks, it was said, had neither eyes nor ears, the cuttlefish only excepted; their life was a mere dream; they were doomed to eternal silence.

Now, we have learned to admire the beautiful structure of their eyes; now we know that they hear, and with an ear not only open to sounds, but able to distinguish the depth and volume of voices. In some shellfish, the ear is a marvel of beauty; and even the lowest have at least one or more tiny chambers, in which to catch the faintest sound, and a special nerve to carry it to their imperfect mind. A thunder-clap frightens the lobster to death; and the pirates of the north used to threaten the fishermen with the firing of a gun, which would kill their rich freight in a moment and render it unfit for market.

Locusts hear each other, for their strange call invites the female, and is always accepted. Ants, also, are not devoid of such a sense. When the termites are busy building their gigantic houses, watchmen are seen to stand from distance to distance. Every two minutes, with truly marvellous appreciation of time, they strike their tiny tongue against the hollow wall. Instantly a loud hissing is heard, uttered by the laborers all over the vast building; and, with double zeal and renewed vigor, they work in passage and chamber. The proud soldier-sentinel looks carefully around, to see that all are duly employed, waits his appointed time, and then repeats the curious warning. Bees are lovers of music, and know the voice of man. Huber, who, though blind, knew the strange people better than we who have eyes, tells us how they listen to the command of the "bee-father," and follow him wherever he calls them. This fact is well known in the East, where the owner draws them thus from their hives into the fields, and leads them back again by a hiss or a whistle. Hence, "it shall come

to pass, that the Lord shall hiss for the fly and for the bee that is in the land of Assyria."

How easily spiders are made to know the voice of their master, is familiar to all, from many a sad prisoner's tale. When the great and brilliant Lauzun was held in captivity, his only joy and comfort was a friendly spider. She came at his call; she took her food from his finger, and well understood his word of command. In vain did jailors and soldiers try to deceive his tiny companion. She would not obey their voices, and refused the tempting bait from their hand. Here, then, was an ear not only, but a keen power of distinction. The despised little animal listened with sweet affection, and knew how to discriminate between not unsimilar tones! So it was with the friend of the patriot, Quatremère d'Ijonville, who paid, with captivity, for the too ardent love of his country. He also had tamed spiders, and taught them to come at his call. But the little creatures were not only useful to him, but to the nation to which he belonged. For, when the French invaded Holland, the prisoner managed to send them a message that the inundated and now impassable country would soon be frozen over so that they would be able to march over the ice-bridged swamps and lakes, though spiders, true barometers as they are, had taught him to read, in their queer habits, the signs of approaching weather. The frost came, and with it the French; Holland was taken and the lucky prophet set free. The spiders, alas! were forgotten.

Even the "hateful toad" has been the captive's friend and companion, and shown itself endowed with a fine ear

and remarkable talents. They come out of the dark night of their holes, when their self-chosen master's voice is heard. They take flies from his hand; but, what is the strangest of all, they actually learn to measure time; for more than one well-authenticated instance speaks of their having appeared only at stated times, when the jailor was absent and all was safe.

Vile, venomous serpents and their kin have an ear as subtle as their tongue, and show a curious love of sweet melodies and gentle words of affection. The hooded snake, as many of us have seen in the East Indies, is fierce and furious, when first captured. But the so-called conjuror rouses her wrath still more by blows and threats; the next moment, however, the blandest words woo and win her heart, and weave a charm which even the crafty snake cannot resist. Anon he raises his hand as if to strike; she follows it with wistful eye and playing tongue. It is a sight of strange, irresistible beauty, this combat between man and serpent. Each watches with intense attention—the dusky Indian ready to strike with brutal force, the cunning reptile waving in graceful curves, raising the strange spectacle-mark that surrounds her glittering eyes, and gathering venom for the fatal bite. But man remains the master. Now with soothing words, and now with soft caresses, he tames her fierce temper. Then he calls in the aid of music, and soon the animal raises her head as if in a rapture of enjoyment, and in a short time learns to weave quick mazes in the air, to twist and twine in most beauteous lines, and follow the master's hand wherever it bids her. Pliny tells us of sons of the

African desert, who, with their eyes' glances alone, could rule over serpents. That race of men is lost; but many a Nubian may be seen at the upper falls of the Nile, who can imitate, with surprising precision, the call of the reptiles, and tempt them to come forth from every corner and crevice.

Vipers, also, and adders, are neither deaf nor dumb, and cannot help listening to the voice of temptation. They were, it is well known, formerly much used in medicine; and the precious theriak, known even at the time of Nero, and still manufactured in Venice, Holland, and France, consists mainly of the flesh of vipers. So, poor, persecuted animals, they are caught in all countries, and—who would have thought it?—almost always by means of their acute hearing. In Italy, grim, swarthy men, of gipsy cast, are seen to stand in the centre of large hoops, and then to indulge in strange, fanciful whistlings. After a while, an adder is seen gently to glide up; another, and still another, appears, no one knows whence; and all gazing with glittering eye at the quaint musician, raise their spotted bodies up against the magic hoop. The deceiver takes them, one by one, with a pair of tongs, and thrusts them into a bag that hangs on his shoulder. The poor, deluded vipers are then carried to town, and kept by druggist and doctor, or sent in boxes, filled with sawdust, alive all over the world. The French, of all nations on earth the most cruel to animals, have a still more wicked way of catching adders. They take the first they obtain, or any other snake they can seize upon, and, throwing it into a kettle of boiling oil, there roast it

alive. The fearful hissing of the tortured creature is heard by its kindred; they come from under sunny banks, from the low furze and scrubby bramble bushes, and as they approach they are eagerly seized with hands defended by leather gloves. Some have said—men of Maine, we surmise—that it serves them right, because they are very intemperate reptiles. Naturalists—wine-bibbers themselves—have placed vessels filled with wine under hedges and near piles of stones; the thirsty vipers come from all sides, and, soon getting drunk, fall into the hands of their captors.

Fish have no visible ear, it is said, and no external avenue for sounds from a distance. Still, they hear with great acuteness. On the continent of Europe, few castles and villas are without the favorite pond, and its broad-backed carp and speckled trout. They all learn to obey the ringing of a bell, and come in eager haste to seize the morsels that young and old are fond of seeing them catch. Lacepède even speaks of some carps of venerable age that were kept in the gardens of the Tuileries for more than a hundred years. They would come not only at the usual signal, but actually knew the names that were given them, and rose to the surface as they were called. They were, however, haughty and proud, for they listened only to those they loved, and in vain were sweet words, in vain even tempting morsels, offered by strangers. The royal pensioners disdained to receive alms; they took only the crumbs that fell from the table of their master, the monarch. But even plebeians among fishes hear; and it is not the fastidious carp only that

cannot bear the grating sound of sawmills, and has his nerves shaken by the firing of guns. Sturgeons also are frightened by loud cries, and thus driven into the fisherman's net; and the bleak-fish detests a drum so that he rather surrenders than endure its abominable rolling. An Italian has, of late, proved in a brilliant manner, that fishes can not only hear, but actually obey and execute orders, that, in fact, they show much higher endowments than they have heretofore been thought to possess. He has tamed a variety of fishes, from the humble tench to the gorgeous goldfish of China, and as he bids them, they come and go, they rise or sink, and display their rich, ever-changing colors. Nay, they perform a miniature drama: a pike seizes a trout, and lets it go or brings it up to the surface, as the master commands with his voice.

It needs no proof to establish the hearing of higher animals; but even the lowest among them, and those that are almost mute, show their appreciation of sounds when carefully watched. The shapeless hedgehog, when tamed, will uncoil at the word of his owner, and the grotesque seal raises its uncouth head, with such beautiful eyes, high out of the water, to listen to music on shore. It loves to hear gentle voices, and is grateful for kind words. Of all things else, they bind it firmest to its master, and call forth its warmest affections. The tiny mouse, that finds a home in the hut of the Alpine herdsman, becomes there so tame, that it points its silky ears and approaches at the whistle of the Senner, when at night he returns to his meal and his rest. Even with us, it has been known to come timidly out of its corner, to listen to a song.

The ancients say much of the delight with which the grazing herd listens to the flute of the shepherd. The Swiss, on his meadows and Alps, also knows full well how exquisite is the ear of his magnificent cattle. There, in far greater freedom than in the narrow valley below, in the pure, bracing air of lofty mountains, with a clear, blue sky above, and rich, fragrant pasture around them, all their senses are sharper, all their instincts more fully developed. The leading cow, with the largest of bells, is not unconscious of her honor and station. She shows it in her more stately gait, she affects a proud and haughty carriage. Woe to the bold intruder who should dare to precede her! But woe also to the wanderer from another herd! She knows, and they all know, in an instant, the tone of a bell that belongs not to their set; and, with eager curiosity, often with savage hatred, they run to meet the stranger, and show her no mercy. But oh! the grief, when the bell is taken from her! As upon leaving the stable of her home, or her own favorite pasture high on the mountain, so when she has to part with her love and her pride, she will weep bitter tears; and many are the instances of cows that have died when deprived of their harmonious ornament.

Some animals, on the other hand, detest certain sounds. The Sophist Acteon, in his seventeen books on the nature of animals, speaks of the strong aversion Greek wolves had to the flute, and tells the oft-repeated story of Phytochares, the musician, who saved his life from the fangs of a hungry pack by playing, with heroic perseverance, on that instrument. The Far West of our own day has

the same account, only, here it is a modern "fiddle," and the poor owner is caught in a cabin surrounded by fierce wolves, mad from starvation. He plays, and they listen with horror; he rests for a moment, and they are ready to rush upon him. High on a rafter, at last, sits the sufferer, playing through the dark hours of night. String after string has broken, his arm is tired, his hands are benumbed. But, just as the last string snaps, as his hand sinks powerless at his side, and, with exulting yells and glaring eyes, the blood-thirsty host leap upwards, the bright light of day breaks through the forest, and the wolves, true children of the night, flee in terror. Even the fierce lion, it is said, cannot bear the cock's crowing, and, like the great Wallenstein, dreads it more than all things earthly. Of the horse, we are taught that

> "At the shrill trumpet's sound he pricks his ear,"

and

> "At the clash of arms, his ear afar
> Drinks the deep sound and vibrates to the war."

Who does not know the account of the Libyan mares, that could only be milked when tamed by soft music, and of the horses of the Sybarites, that had been taught to dance after pleasing melodies, and then, when bearing their masters into battle, suddenly heard, in the enemy's ranks, the well-remembered sounds, and instantly set to dancing instead of fighting? The same love of music has been more harmlessly employed in comparatively modern times. The eccentric Lord Holland, of the reign of William III., used to give his horses a weekly concert in a covered gallery, specially erected for the purpose.

He maintained that it cheered their hearts and improved their temper, and an eye-witness says that they seemed to be greatly delighted therewith.

In the elephant and the camel, this sense is, probably most strikingly developed. Whole books have been written on the marvellous talents of the former, and wonders have been told of the great effect that music has on his temper. Sweet, gentle melodies move him to caresses; loud, powerful strains rouse his passions even to uncontrollable fury. The camel has been less fortunate. Still, it is never beaten by its owner, whether it toils panting through the deep, hot sand of the desert, or shivers, sewed up in blankets, in the icy regions of Siberia. At home it is, at worst, only scolded; on the journey, it is controlled by words, to which the pressure of the foot on the neck, or a gentle touch with a rod, only serve as accent or emphasis. The Arab, a true lover of animal creation—the pig excepted—entertains his camel with music, with songs, and with fairy tales. Often and often they may be seen, travelling in the dead of night, gliding along like spectres in the moonlight, or bearing torches on their packs, which cast strange flickering lights on the dismal waste. Their heads on high, their long necks balancing slowly to and fro, they move carefully and yet swiftly, sometimes thousands in number. Nothing is heard but the faint rustling of the sand, as it grates under their soft feet, and the plaintive sound of the Arab's voice. He is overpowered by weariness, or dreams of his home near bright waters, where the palm-tree casts a cooling shadow. The camel lags and lingers—it stops. Then the roused

Bedouin draws his reed-pipe from the folds of his turban, and, sharp and shrill, its notes are heard far into the solitude; while the camel raises its ungainly head, and, with enlivened step and rapid motion, moves forward through the desert.

Birds alone, and especially singing birds, have a genuine ear for music. As the eye may see, and yet not be able to distinguish colors, so the ear of most animals hears, but cannot discern the depth and volume of tone. But birds are the true musicians of the animal kingdom. They have, what many men lack, a genuine talent to learn and appreciate musical notes and melodies. You sing, and they will repeat, bar after bar; others listen with eager attention to a hand-organ, and, little by little, learn whole tunes; the ablest of all even imitate the songs and voices of others.

Not all animals, however, that have an ear, can speak. Language, even in its humblest form, is a gift vouchsafed to the few and the privileged. Still, animals are dumb only in a general way; they all have, at least, a language of instinct. By this they can make themselves understood by their own race and by their enemies. Even the lowest among them, that have not a trace of lungs, must have some gesture to convey their friendly or hostile meaning. Poor as it is, no doubt, and entirely as it escapes our eye, this language suffices. Animals endowed with horns, teeth, feet, or antennæ, speak by these means; how eloquent is the dog when he shows his teeth, and how sure of being understood the ox, when he lowers his formidable horns.

Clearer far, though still only in gesture, is the language of others. Their eye speaks to the careful observer, as clearly as the eye of man, of their innermost feelings; their whole carriage, the play of their features, the gestures of their limbs, are full of unmistakable expression. Here, as in man, we observe a beautiful harmony between the bodily frame, and the spirit that dwells in it. This they read, unconscious but unerring, in others also. The dog, taught by his constant intercourse with us, sees in our mien and gesture, at once, whether he pleases or not; the horse, also, can learn to appreciate a frowning brow or a kindly face. They are infallible in this, perfect as in all that comes from nature directly. Their instinct never errs, as the infant's pure mind judges far more correctly than the troubled mind of the old and experienced. Even the wildest of carnivorous beasts perceive, by these means, in man a higher spiritual power. The lion reads in his eye the consciousness of his superiority, and shrinks from it with shy submission. But woe to that man whose heart should fail him, who but for a moment forgets that he is master of all things living on earth! The lion, at once, feels himself the better and stronger of the two, and his blood-thirsty instinct regains its supremacy. And as they read the mysterious language of features, so they express it. There is no hypocrisy in the animal's face. It would be a sad error, indeed, to fancy that there was nothing to read in look, mien and gesture of animals, simply because, to us, it is an unknown tongue. We cannot even distinguish individuals of our own kind. To the white man of Europe, all blacks look

alike, and, at first sight, nothing strikes the inexperienced traveller so much as the apparent similarity of eastern nations. Who of us can read temper or health in the faces of a thousand sheep? and, yet, the shepherd knows every one by unfailing signs, and is struck, at a glance, by a change of expression. We are apt to forget, besides, that there is among animals no disguise of features. We all know, in an instant, an intelligent dog by his eye and his gestures. Then, our face is smooth and tender beyond all parts of the body, that of animals is covered with hair, and, although we may see a dog move his lips to a smile, and his eye most plainly shed tears, but little can be read in his dark, hairy countenance. The blood may come and go as quickly as the crimson blush on our cheek; he may "turn up his nose," and "frown with indignation" without our seeing any trace of it.

Man's superiority in this language is great, but it is artificial. He is independent of the body, which the animal is not. Hunger may sorely try him, and anger devour his heart: yet he can suppress every sign of his want and his passion. On the other hand, he can exhibit feelings which are not there; the actor expresses a feigned condition of soul; the courtier, even, represents feelings the very opposite of those that actually move him.

Still, animals even may develop this humblest and simplest language. They resemble the infant, that, in early days, learns to understand the mother's loving look, that cries for food, and soon smiles, in return for caresses, or laughs in its child-like enjoyment. There is little but fierce temper in the mustang's hairy face—there is a world

of feeling in the thorough-bred's well-cut countenance. The cur of the Turk shrinks, howling, from the stern glance of man, and snarls and snaps at his enemy—the intelligent spaniel has an eye beaming with affection, and speaks a language of gestures as clear and distinct as that of actors in pantomime. Who has ever forgotten the touching tribute paid by blind Homer to the faithful dog of Ulysses? Forgotten by all that loved and served him, disguised by the great Athene herself, he returns to his home, and wanders, unknown, among his friends and his kindred. But, as he speaks in the yard to Eumæus, the lame and emaciated friend of his youth, his own beloved Argus hears the voice of his master. He would fain rise and greet him, as of old, with fondling caresses and eager barking. But he is old and crippled, he can but wag his tail, and tenderly lick the hand that he alone has recognized. And as his master, brushing away a furtive tear, enters the hall, where abundance reigns and joyous voices are heard, poor Argus lays himself down and dies of immoderate joy.

Far clearer, of course, and more familiar to all, is the language of animals uttered in sounds. Yet this, also, is, as yet, but a tribe of unknown tongues. We are so apt to watch only for sounds that resemble the human voice. We look for a phonetic language, which, of course, is not taught among animals in primary schools by means of primers and readers, but by their only mother, nature. We forget, that when first we enter an asylum for deaf mutes, we hardly observe the imperceptible signs that pass, with amazing rapidity, from hand to hand. We forget the

terror with which early travellers spoke of the wondrous gestures used among eastern nations, where the feasted guest from the west was often startled to find that a wave of the hand, which had passed unnoticed before his eyes, had been an order to behead an offender. And yet we ought, in our day, to have learned to think most humbly, indeed, of our own imperfect senses. Who guessed that there was a world of suns and stars in the heavens before the telescope unfolded its wonders? Were we not all startled with the Brahmin, whose laws forbid him to eat animal food, and to whom the merciless microscope revealed in his cup of pure water a host of living beings? If we had instruments for the ear, as we have for the eye, who knows what we might hear, though we should never reach the fabled power of the Eastern magician, who saw "the grass grow and heard the fleas coughing." But we might surely expect to learn some of these now utterly unknown tongues, and to discover for instance, the mysterious language which ants and bees speak to each other with their antennæ. Observations and study would soon add largely to our stock of knowledge. We have all noticed how still and silent nature appears, at sultry noon, when a feeling akin to awe creeps over us, and a magic slumber seems to seize and enchain whatever is living. But, even then, there remains an all-pervading sound, a restless humming and fluttering, close to the ground. In every bush, in the cracked bark of trees, and in the earth, undermined by insects, life is still audible; voices are still heard, low and faint, perceived only by the watchful ear and the reverent mind of the true votary of nature.

All language of animals must, of course, be limited in a two-fold direction. They cannot express more than they feel or think; hence their wants only, their emotions of joy and suffering, are thus communicated to others. They have language, but not speech. That is man's high and heaven-born endowment. Then, reptiles, birds and mammalia, alone, have the power of vocal utterance, insects and others are mere instrumental performers. Of the vocalists, again, reptiles produce sounds with the palate only, snakes excepted; mammalia with their lips, as children do when they begin to lisp; birds alone speak with their tongue also, and, thus enjoying double organs of utterance, possess the most perfect of unknown tongues.

The language which animals speak, by means of friction, or concussion, is, naturally, the least known of all. We see the eager ant rushing homeward to tell the news of an invasion; she meets a friend, their antennæ touch and play with each other, in rapid succession. The messenger returns, the latter conveys the news by the same means to others, until the whole army is informed. Here we see, not an instinctive feeling of dread, but a clear, undoubted communication of facts. So among bees: the instant the queen dies, the sad event is made known throughout the hive. No sound, perceptible to human ear, is heard, but the antennæ move with surprising effect, and as the result of a clear act of volition. It is not a sensation, merely, nor an instinctive action, but it has all the signs of special purpose. How they speak, we know not; this, only, is certain, that their language is

not like that of the deaf and dumb, with whom signs represent letters or words.

The cricket, even, is not without its note of utterance, and, although a purely mechanical sound, it has its sweetness and charm, so that Milton could speak of being

> "Far from all resort of mirth
> Save the cricket on the hearth."

It produces a loud, clear sound, by a quick vibration of the elastic skin between its wings; and from the time when the Athenians wore the golden cicada in their hair, to our days, when the cricket on the hearth is the proverbial image of home comfort, its simple note has been dear to the heart of man. The true cricket, however, speaks only in the sunny time of love. The male begins, in his hermit-cell, as May approaches, to produce a low, inward note of longing. As the sun rises higher, and summer advances, his shrill song becomes louder, until he finds the desired companion. Then he returns to his solitary life once more, and his voice dies away by degrees. Dean Swift has left us a humorous description of the curious note of the death-watch beetle. The little fellow, in his narrow cell, falls in love; immediately, he begins to thump his head against the ground, and uses such energy in his demonstration that he leaves deep marks in the softer kinds of wood. The powerful stroke produces a loud sound, the infallible presage of death to superstitious man, the soft music of love to the female beetle. If other males are within hearing, they all join in the concert with furious

knocking, and such is their jealousy or their zeal to answer, that even the ticking of an innocent watch excites their wrath and their loudest notes.

The bright troops of virgin-moths and fresh-born butterflies, seem to speak by the brilliancy of their colors only, and thus to appeal through the eye to the heart of their beloved. Darwin tells us, however, of some in South America, who, when a pair are chasing each other, make a clicking noise that is heard at considerable distance. That charming traveller found they had a kind of drum near the first pair of wings, by which they produced this noise to attract the female. The spinax, (atropos,) clad in sad colors, and quaintly marked, actually utters a low whine, when caught, and thus presents the lowest voice of suffering known in the animal kingdom.

The craw-fish, also, has but a single note of pain; when drawn on shore, it utters a low, angry sound, that seems to rise from the innermost parts of its curious body. Naturalists speak, besides, of a gentle, humming noise, resembling that of beetles, which it makes when enjoying the sun and its genial warmth; it ceases, however, the instant any other noise is heard, and has thus been but rarely observed.

"The voice of the turtle is heard in the land," but it has little to please the ear or to attract attention. Nor are fishes better endowed in point of language. They have a thick, immovable tongue, adhering firmly to the lower jaw. A voice would, however, be of small avail to them in an element so little sonorous as wa-

ter. A German enthusiast tells us, it is true, that they speak in light, scarcely perceptible breathings; but no one else ever heard them. Still, some of them actually do utter noises of various and seldom agreeable nature. Tenches have a croaking sound, which is heard when they are caught, and as long as they are living. The armado, of South America, has a harsh, grating noise, which it utters even beneath the water, and others pipe and whistle or growl and grunt, as the grunter and sea-scorpion. The drum-fish, of our waters, has his name from the skill with which he drums on his own inflated body. It is heard best when he passes under a vessel, and poetical mariners have compared it to the bass notes of an organ, the ringing of a deep-toned bell, or the melancholy sounds of an Æolian harp. The dolphins, the great favorites of antiquity, were said to love music even more than human beings, and to cry in pain and anguish. Aristotle tells us that one of this race, caught and wounded near Icaria, cried so loud and bitterly, that thousands came swimming into the quiet harbor. The fishermen gave the wounded one its liberty, and then they all left, expressing their joy in graceful gambols and endless gyrations.

Frogs are veritable artists and masters in one of the unknown tongues. They have a true voice—not the result of mere mechanical action, but proceeding from the lungs, and expressive of deep feeling. So, at least, think the Mahometans, to whom they are sacred, because they proclaim to the world the praises of Allah—and even more so, because of their marvellous piety. For, when

the Chaldeans had captured the great patriarch, and thrown him into the fire, to be burnt unto death, hosts of indignant and sympathizing frogs appeared from all sides, and, pouring water on the flames, rescued the Holy Father. Horace detested them, in common with Italy's own peculiar plague; they disturbed his sleep on the famous journey to Brindisi. The peasants of France, too, pursued them, at one time, with almost intense hatred. No wonder—for they were, by law, compelled to beat, night after night, the water in moats and ditches around the nobleman's castles, that the croaking of frogs might not disturb his lordship's slumbers! Their song, we fear, is not much more appreciated in our day. In vain do we associate it with the return of spring, the sense of genial warmth and the renewal of fuller life and vigor. They have but a single sound, the *U*, and this they utter through the whole diapason, in all possible height and depth, from spring until autumn. They are a merry set of summer beings. Buried in deep slumber during winter, the first rays of the spring sun awake them to life. At first lazy and silent, they revive as earth and water grow warmer. Beautifully dressed in green hunter's garb, their bright, lively eyes set in golden frames, they squat gravely down on a sunny bank, and, opening wide their huge mouths, they look the very picture of homely comfort and broad humor. They have no lips, and have the appearance of being doomed to eternal silence. But they know, very soon, how to swell their wide throats, that shine in dark nights, and to puff out the huge cheeks with their enormous air-bladders inside. How lustily the

males call out their classic Brekekekex, co-ax, co-ax! whilst the females only hum in low, humble tones. First, the leader's loud, coarse voice breaks forth in solemn intonation; then the others, sitting in a wide circle around him, follow in long responses; and at last, from far and near, from every pond and every puddle, their deep-toned voices are heard in one mighty chorus. It is the mere outbreak of joy and delight; they know neither melody nor order. Each sings as he likes best, at his own time and in his own particular key. They are, apparently, vastly amused at their own great talkative powers; for, every now and then, they break out in the happiest laughter known in animal creation. Its gusts are so sudden, its tones so boisterous and loud—as if they would burst with sheer happiness and joy. When they assemble in large numbers, as the tree-frogs love to do in Paramaibo, and the countless hosts of common frogs on the banks of the Wolga and the Caspian Sea, they absolutely drown every other noise. There millions join in the fearfully monotonous concerts, until the earth trembles, and for miles no sound is heard but their own hoarse croaking. Although they all have one voice for the concert and another for family matters, their note is nearly the same all over the world—only in South America, we are told, a tinier frog will sit on a blade of grass, a little above the surface of the water, and utter a pleasing chirp, which joined by others, has the effect of a harmony of different notes. The bullfrog's deep, disproportionate voice has frightened many an innocent wanderer from Europe; he seems to enjoy the sport, too, for he grows the louder

the surer he is of attention. After a short, happy summer, their voices gradually weaken; they strip off their delicate dress, which is so thin that it looks upon paper like a faint pencil-drawing; they eat it with apparent delight, and soon after vanish from the sight of man. Silent and benumbed, they sink again into the ground, to pass the cold season in quiet, unbroken slumber.

IX.

A Trip to the Moon.

The moon shines white and silent on the mist,
  On the mist, which like a tide
Of some enchanted ocean
  O'er the wide marsh doth glide,
Spreading its ghostlike billows
  Silently far and wide.

A vague and starry mystic
  Makes all things mysteries,
And moves the earth's dumb spirit
  Up to the longing skies.

J. R. Lowell.

THE huge bell of the cathedral rang out midnight. Like clear crystal drops fell the transparent notes from the bright sky, as if they were echoes of angels' voices. Behind the dusky mountains rose the full orb of the moon in golden splendor, and poured its fairy light over the vast plain. Faint hazy mists swept across the valley, and slowly the pale gossamer light sank deeper into the dark narrow streets of the city. A gigantic churchyard the silent town lay at the feet of the mys-

terious globe in the high heavens—each house a coffin in which slept a thousand joys or sorrows. Only through one low window shone the feeble glimmer of a night-lamp. A mother was watching her sickly babe; fierce fever glared in its glowing face and burning eyes, and restlessly the poor child tossed from side to side. At last it grew quiet, and seemed to slumber. The mother stepped to the window, and looked with tearful eye up to the moon. A feeling of deepest loneliness chilled her sinking heart; all around her slept ten thousands in happy peace; the wicked had ceased from troubling and the weary were at rest; she alone was in sorrow and watched with anguish the flickering life of her beloved.

"Oh," she sighed, "how peaceful and happy it must be up there in the silvery light of the moon! There is peace in her pale even light, quiet happiness in her calm, unbroken pilgrimage through the dark blue heavens!" And she wished she could wander in her sweet meadows and rest by her still waters. She prayed, half dreaming, half awake, that her soul might, hereafter, be allowed to rest from the pain and sorrow of earthly life, in the calm sweet light of the moon, praising God and enjoying the peace that knows no end.

For so we dream, even in our day, of paradisiacal peace and mysterious charms in the moon; as thousands of years ago, the nations of the earth revered in her a godlike being, who lighted up the long, sad nights with her sweet silvery light, and in chaste beauty, wove strange spells over the hearts of men. They built temples in honor of the goddess, priests sang her praises in mighty

anthems, sacrifices won her favor and disarmed her just wrath. Lofty were her thrones in the far East; Asia and the world worshipped her, and great was the Diana of the Ephesians!

This faith, like alas! many a better faith, is found no longer among men. Superstition, alone, has remained. The Chinese beats his drums and gongs to keep the great dragon from swallowing up his moon at the time of an eclipse, and the Wallachian peasant sees in her pale, faint glimmer how the vampire rises from his brother's grave. With us the telescope has stripped the moon of her divine attributes, and dry, sober calculations have torn all strange fancies and gay charms from the humble satellite of the earth.

Now the moon is simply a little globe, not much larger than America, so that the longest journey, that could be undertaken there, would explore Asia from end to end. We can easily get there, for she is only about two hundred and forty thousand miles from us, a mere trifle in comparison with the distance of the nearest star. Will you accompany us? There is no luggage required, for there are plenty of castles in the air, and as for provisions, have not our very first lessons taught us the precious substance of which the moon is made? Passengers are not expected to travel with a huge telescope under the arm, and a book of logarithms in their hand. We leave that to the munificent Earl of Rosse, who compels the chaste goddess to come down within the familiar distance of three hundred miles, even to bold Ireland! We have, besides, cunning astronomers, who marshal with ease millions of

numbers, and command the poor planets to appear in given places, threatening to deny their identity, if they are not there within the minute. We are simple travellers, and, I fear, would not disdain the aid of a beanstalk, if we thought it the shortest road to heaven.

Once on the moon, however, we are immediately struck with awe and wonder at the strange landscapes that we suspected already from below, even with unarmed eyes, in the dark and light spots on the moon's disc. Now the gray portions become plains, the light ones mountains. That these brilliant spots are mountains, we know from their shadows, which always fall on the side opposite the sun, and which lengthen in precise proportion as the sun sinks lower. The most dazzling points, however, are not mountains but towering precipices, whose steep, smooth sides reflect the light with greatest force.

But how entirely different is this mountain scenery from that of the Alps or the Andes! Here we see no lofty, snow-covered peaks, no long, pleasing ridges and lovely valleys; not even the proud domes of the Cordilleras with their steep terraces are here represented. The whole surface of the moon is covered with circular walls, inclosing deep, dark caverns, into which whole territories have sunk with their hills and mountains. Some of these huge abysses are more than fifty miles in diameter, others spread still wider, but all are engirt at the top by great walls of rock, which are serrated and often crowned by lofty peaks. The smallest and most regular are called craters, from their resemblance to the craters of the earth, but the form is all that they have in common. Volca-

noes the moon does not know, and the shining points on her night side, which Herschel loved so much to observe, are only the highest points of lofty mountains, resplendent in brilliant sunshine.

On the southwestern part of the disc we see one of those gigantic, elevated tablelands, with which the moon abounds. They are evidently the oldest formations, fearfully torn and tarnished in every direction, full of craters, fissures and fractures, and traversed by long furrow-like valleys; but in their midst we see, invariably, a most beautiful variety of landscapes, such as our earth boasts of: groups of mountains, broad, vast plains, gently swelling ridges, and fair valleys, dotted with numerous, well-rounded hills.

By their side we notice one of those regular, and therefore probably more recent, circular mountains, of which more than one thousand five hundred are already known, and which, in some parts of the moon, stand so closely packed together, as to give to these regions the appearance of a honeycomb. Their walls are nearly all around of the same height; within, their straight, steep sides sink suddenly into the abyss; without they fall off more gradually in terraces, and send occasional spurs into the surrounding country. In the centre there rises commonly an isolated peak, sometimes merely a humble hill, at other times a lofty mountain or even a small cluster of conical eminences. These central heights never rise to a level with the circular ranges; some are nearly five thousand feet high, but then the impassable wall, that surrounds them without breach or pass,

and shuts them off from the rest of the universe, towers aloft to the amazing height of seventeen thousand feet!

If the number of these circular mountains is so great, that of small, burnt-out craters is still more astounding; even a moderately powerful telescope shows us some twenty thousand. Inside they often sink to an incredible depth, into which their walls cast a deep, everlasting shadow; here there reigns entire gloom, which the light of the sun, even at its highest, never reaches. Their tops, however, when fully lighted up at the time of full moon, shine in glorious splendor, reflecting the sun's rays with dazzling lustre. Others show only their margin illuminated, like a delicate ring of light, forming a magic circle around the dark, yawning crater. Now and then we see two or more strung together like rows of pearls, connected with each other by canals, or even two at a time surrounded by a common wall and combining their desolate horrors.

Continued chains of mountains, like the Alps and Andes of our mother earth, are rare in the moon, and even when met with, only short and without spurs or valleys. The longest ridge extends about four hundred and fifty miles, but its peaks rise to the prodigious height of seventeen thousand feet. On the other hand, the moon abounds in countless, isolated cones, which in the northern half group themselves into long, broad belts. Like the thorns of a chestnut, thousands of these mountains rise suddenly from the plain, and are seen to stretch their long, gaunt arms from the outline of the moon's disc into the dark sky. Even the vast plains of our little neighbor are covered with long, curiously

formed ranges of low hills, which, though often a mile wide, never rise beyond a thousand feet, and therefore show us their shadow only when the sun is extremely low.

Much as these strange forms differ from all we see on earth, we are still more struck with the quaint, mysterious fissures, narrow but deep, which pass in almost straight lines, like railways, right through plain and mountain, cut even craters in two, and often end themselves in craters. At full moon they appear to us as lines of brilliant light, at other times as black threads, and must, therefore, have a width of at least a thousand feet. We have, on earth, nothing to compare with them; for even the terrible gul lies which cross the prairies of Texas, dwindle into utter nothingness by the side of these gigantic rents. As long as men saw every day new surprising analogies between the moon and the earth, and the gray spots were oceans, the light ones continents, these inexplicable lines also appeared now as rivers and now as canals, or even as beautifully Macadamized turnpikes! The citizens of the moon can, however, hardly yet afford building roads of such gigantic width, by water or by land, nor will the fact, that these deep furrows cut through craters and lofty mountains, and invariably preserve the same level, admit of such an interpretation. At all events those only can see canals and roads on the moon, who have already found there cities and fortified places.

What gigantic and astounding revolutions must have passed over the moon, to produce these colossal mountains, rising not unfrequently to a height of twenty-six

thousand feet, these peculiar, massive rings, these enormous cliffs and furrows! How insignificant appear, in comparison, the greatest events of that kind, on our earth, where even proud Ætna hardly rivals the smallest of the moon's craters! Their universal tendency to round forms has led to the idea that all these elevations and indentations are the effect of one and the same mysterious power. Everything favors the presumption, that the moon was originally a liquid mass, and that, whilst it became solid, new forces were unloosened in the interior, causing gigantic eruptions, as when the pent-up air bubbles up from a mass of molten metal. Some of these bubbles would upon bursting, naturally leave behind a circular ridge and a slight rise in the centre of the cavity. These forces seem to have been most active near the poles, whose desolate regions are dotted over with countless hills and mountains; near the equator vast plains stretch out, broken only here and there by a lofty peak or solitary crater. Thus man, pigmy man, ventures already to read the riddles of mysterious events that happened in the earliest times of the history of a great world, which his foot has never yet trodden! He has, however, not only measured the mountains of the moon, and laid out maps and charts of her surface, but he has given names to mountains and islands. Formerly the most renowned philosophers were thus immortalized, we trust without any insidious comparison between philosophy and moonshine. Of late, however, dead or living astronomers, who often enjoyed little enough of this world's goods, have been presented with large estates in the moon. Thus Kepler, whom the great

emperor and the empire of Germany suffered to starve, obtained one of the most brilliant mountains for his share; and Tycho, Copernicus, Hipparchus and Albategnius are his neighbors in those regions, though tolerably far apart on earth, in point of time, country, and religion. Even Humboldt has already his possessions in the moon.

Nothing strikes the general observer so much, when his eye rambles inquiringly over the surface of the moon, as the incredible variety of light in different parts. Some have sought the cause of this striking phenomenon in the diversity of the soil, ascribing to the darker portions a looser earth, and perceiving in the greenish sheen of some plains even traces of vegetation. Doubtful as it must needs be, whether any color could be distinguished at such a distance, this is certain, that the lighter portions represent rigid masses and reflecting elevations. A most strange sensation is produced by the long beams of dazzling light, resembling liquid silver, which, now isolated and now united together into broad bands of rays, pass in countless hosts over whole, large regions. They often centre in some peculiarly brilliant, circular mountain, and the gigantic Tycho sends his rays of surpassing splendor over more than one-fourth of the whole orb, over hill and dale, valley and mountain. At other places they form broad masses of mystic light, often twenty miles square. Mountain ridges or lava streams they are not, though formerly the world believed them such, because they pass over the very tops of mountains. Can they be glassy or crystallized masses of volcanic material, which, suddenly cooled,

now stand in rigid pallor and reflect light with an intensity unknown to us on earth?

As yet we have met with no trace of life on the moon. Are there no inhabitants on our strange satellite? In our day, when the plurality of worlds threatens to become the war-cry of sects and schools, the question is but natural, and many an eager inquirer has no doubt asked himself: what may life be on the moon? Have they built cities and founded empires there like the men of the earth? Does a blue sky smile upon them, and do merry springs leap down the green slopes of their mountains?

Nor is the question altogether of recent date. While Sir John Herschel explored the wonders of the southern heaven on the Cape of Good Hope, there appeared unexpectedly a little pamphlet, which created no small sensation even among the learned. It purported to be his first account of new discoveries in the moon, and contained marvellous reports of sheep of strange shape, of men with the wings of bats, of cities and fortified towns. The world, however, soon found that this was an ingenious hoax from the pen of an American, who had thus practically tested the credulity of his contemporaries. The credit which the clever imposture found, even among the well-informed, is an ample apology for the sanguine expectations of those who still hope, by the aid of improved instruments, to discover the man in the moon; or, like good old Bishop Wilkins, to pay him a neighborly visit, for which, in sober earnest, most ingenious plans have been devised. Distinguished astronomers insist upon hav-

ing seen large buildings in the moon; Gruithuisen tells us of an edifice near the equator, in its most fertile regions, of twenty-five miles diameter and surrounded with large walls, which face, with astounding accuracy, the four quarters of the compass. As it is only *le premier pas qui coûte*, Schwabe, in Germany, soon discovered on the outside some smaller buildings, and even earth-works!

One point, above all, is apparently altogether lost sight of, by those who cherish such sanguine hopes. If we could distinguish a man, or any other object at the distance of five miles, it would still require an instrument, which would magnify objects fifty thousand times, to see anything of that size on the moon. But if the far-distant future should ever produce such an improvement in telescopes, that would only increase, and in alarming proportion, the difficulties arising from the density of our atmosphere and the daily movement of the earth. Even with our present instruments, far as they are yet from the desired power, these impediments are so great as seriously to impair their usefulness. All that has as yet been accomplished is to see objects of the extent of one hundred yards; perhaps we may, ere long, succeed in distinguishing works of the size of our pyramids and largest cathedrals; but at best they will only appear as minute points, far too small to exhibit form or shape.

The eye, then, is utterly incapable of discovering life-endowed beings in the moon. This would, of course, in itself not preclude the existence of inhabitants in that globe. Every argument, on the contrary, leads rather to the conclusion, that the life of other worlds is, on the

whole, governed by the same laws as that of our earth. The same infinite variety which astounds the eye and the mind of man, when he studies our animal creation here below, and the exquisite adaptation of these countless forms to their precise purpose, must needs continue throughout creation. God is not only great, but also consistent in his greatness, and the eternal laws of nature, which are, after all, but an expression of His will, must apply to other worlds also. The inquiring mind will, therefore, not without benefit try to derive additional knowledge even from the scanty facts with which we are as yet only acquainted.

We know tolerably well the soil, the climate and the surface of the moon. What, then, do they teach us as to life on that globe? The first circumstance that strikes the traveller on the moon, is the wonderful facility of motion. Gravity is in the moon six times less than on the earth, so that the same power with which we here lift eighteen pounds would there raise a hundred weight. The arm that can throw a stone on earth ten feet high, would on the moon throw it up to sixty feet. The inequalities of the soil there would, to an earth-born man, be no difficulties; he would glide over hills and mountains, which here below require gigantic structures, with the ease of the winged birds of heaven. This must at once produce a radical difference between life on earth and life on the moon.

If we look next for the two great elements of earthly life, air and water, we find that the moon is but ill provided for in that respect. With all sympathy for great

discoverers and sanguine optimists, we are compelled to deny the existence of either water or air, such as we have them on earth, in our satellite. We know the presence of air by the fact that all air breaks and weakens rays of light, which pass through it. The atmosphere of the moon shows no such effects. Her landscapes appear as clear and distinct on the margin as in the centre of the orb, and when stars pass over the latter, they show no diminution of light at the time of their entrance into the luminous circle, no increase of light when they leave it again. The evaporation of water also, would be betrayed by the same breaking of rays, if that element were mixed up with the air, as it is in our own atmosphere, or if it covered any part of the moon's surface. Unwilling as we are to banish her inhabitants exclusively to that side of the moon, which human eye has never yet beheld, because it is constantly turned away from the earth, and there, at fancy's bid to revel in a paradise with purling brooks and balmy zephyrs, nothing is left but to assume that the air is too thin and the water too ethereal to be perceived by the instruments now at our command. The careful calculations of the great astronomer Bessel resulted in the bare possibility of an atmosphere, a thousand times thinner than our own, showing conclusively how little we can expect to find life on the moon to resemble in any way life on earth. The inhabitants of that world, if there be any, must have other bodies than ours, other blood must run through their veins, and other lungs breathe their air—*we* could never live in such a world.

And what a curious almanac these good people in the moon would have! There, days are as long as years, and day and year are equal to our months: twenty-nine days, twelve hours, and forty-five minutes. The seasons differ but very little from each other. On the equator there reigns eternal summer, for the sun is ever in the zenith; the poles are buried in eternal winter. The days are of equal length throughout the year; all days equally light, all nights equally dark. The absence of an atmosphere deprives the moon of the sweet charms of a twilight, and glaring day would follow gloomy night with the rapidity of lightning, if the slow rising and setting of the sun did not slightly break the suddenness of the transition. Human eyes, however, could not bear the fierce contrasts of light and shadow; they would long in vain for the soft intervals between the two extremes, the other colors, which beautify our world with their joyous variety, and soft harmony. The sky is there not blue, but even in daytime black, and by the side of the dazzling sun the stars claim their place and shed their light in the heavens. Near the poles the mountain tops shine in unbroken splendor year after year, but the valleys know neither day nor night, for they are ever but scantily lighted by the faint glimmer reflected from the walls that surround them.

That side of the moon which is turned away from us, has a night of nearly fifteen days; the stars only, and planets, shine on its ever dark sky. The side we see, on the contrary, knows no night; the earth lights it up with never ceasing earth-shine, a light fourteen times

stronger than that which we receive from the moon. We recognize our own light, lent to our friend, in the faint, grayish glimmer of that portion of the moon which before and after the new moon receives no light from the sun, but only from the earth, and reflects it back again upon us. Mornings in fall show it more brilliant than evenings in spring, because in autumn the continents of the earth with their stronger light illumine the moon, while in spring she only receives a fainter light from our oceans. Our orb appears to the man in the moon as changeable as his home to us, and he may quite as correctly speak of the first or last quarter of the earth, of new earth and full earth. The whole heaven moves before him once in twenty-nine days around its axis; the sun and stars rise and set regularly once in the long day; but the vast orb of our earth is nearly immovable. All around is in slow, unceasing motion: the mild face of the earth alone, a gorgeous moon of immense magnitude, never sets nor rises, but remains ever fixed in his zenith. It there appears sixteen times larger than the moon to us, and daily exhibits its vast panorama of oceans, continents and islands. Bright lights and dark shadows are seen in ever varied change, as land or water, clearings or forests appear, new with every cloud, and different at different seasons. The man in the moon has thus not only his watch and his almanac daily before him in the ever-changing face of the earth, but he may, for all we know, have maps of our globe which many a geographer would envy on account of their fullness and accuracy. Long before Columbus discovered

America, and Cook New Holland, our lunar neighbor knew most correctly the form and the outlines of the new continents. There was no New World for him, and there is none left. He could tell us the secrets of the interior of Africa, and reveal to us the fearful mysteries of the polar seas. But how he on his side must marvel at our vast fields of snow, our volcanoes and tropical storms and tempests—he who knows neither fire, nor snow, nor clouds! What strange fables he may have invented to explain the shadows of our clouds as they chase each other over sea and land, and hide from him in an instant the sunlit landscape! And stranger still, on the side of the moon which is turned from the earth, he knows nothing at all about us, unless news reach him from the happier side. Or he may undertake—the great event in his life—a long and painful journey to the bright half of his globe, to stare at the wondrously brilliant earth-star, with its unread mysteries and marvellous changes of flitting lights and shadows. Who knows what earnest prayers may rise from the moon also, full of thanks for the floods of light and heat we pour upon them, or of ardent wishes that their souls might hereafter be allowed to dwell in the bright homes of the beauteous earth-star?

Only in one point has the dark side of the moon a rare advantage. With its dark, unbroken night, a true and literal "fortnight," it is the observatory of the moon, and the best in the whole planetary system. There no light from the earth, no twilight, hinders the most deli-

cate observations, and neither clouds nor fogs ever step between the telescope and the heavenly bodies.

It is a cold world, however, all over that pale, lifeless globe. The rays of the sun can hardly warm that thin, imperceptible atmosphere, and on the plains near the equator, a fortnight of scorching sun and burning heat, which parches and withers all life, is instantaneously followed by another fortnight of fearful cold. Human eyes could not bear this ever cloudless, colorless horizon. Over the mournful scene that looks like one vast ruin of nature, broods eternal silence. The thin air cannot carry the waves of sound. Not a word, not a song is ever heard amid those desolate mountains; no voice ever passes over the sunken plains. Pain and joy are equally silent. A rock may glide from its ancient resting-place, a mountain may fall from its eternal foundation — no thunder is heard, no echo awakened. Grim silence reigns supreme. No rainbow is set in the clouds as a token from on high; storm and tempest give not way to the merry song of birds and the breath of gentle, balmy winds. There we look in vain for green forests with their cool shade, for playful fountains to cheer and to refresh us. Far as eye can reach we see nothing but bare mountains, desolate masses of rock, countless stones amidst huge boulders of glassy fabric. Human bodies could not endure these long days and endless nights; human souls could not bear that silent, lifeless world of desolation.

Even this universal devastation, however, does not absolutely preclude the existence of created beings on

the moon. We can think as little of a noble tree without leaves, flowers and fruits, as of an orb, rolling in silent, serene majesty through the midnight firmament, without organic life and intelligence. The earth teaches us the same lesson by simple logic. The earth also, once incandescent and scarcely cooled, has been the theatre of fearful convulsions; gigantic forces have torn her interior, and deeply furrowed her surface. But hardly was apparent peace restored upon the still unshapen globe when it produced, at the word of the Almighty, a creation full of fresh life, at first rude, raw and imperfect, like nature itself, but daily growing nobler, more varied, more spiritual. We know this, for each varied organization of such life, as it perished, has left its epitaph written upon imperishable monuments. May we then not believe, that, like the earth, the moon also has had her first period of storm and strife? Of this her vast plains, her rugged craters and mysterious furrows give proof in abundance. The present seems to be her period of rest, during which nature gains strength to produce a life-endowed creation. This we conclude from her unchanging face, and her clear, imperceptible atmosphere. If this be so, then there must come a time for the moon as for the earth, though perhaps after thousands of years only, when thinking, intelligent beings will rise from her dust. The whole universe has some elements in common. The great cosmic powers, light and heat, are the same first conditions of organic life throughout the vast creation; they send their waves through the wide ocean of the world, and play against

the shores of all of its gigantic islands. There is, no doubt, vital power in them, and at the proper time, at His bidding, life will spring forth and order will reign, where now destruction and chaos alone seem to rule supreme.

The moon is one of the great heavenly bodies, all of which work together in beautiful harmony to the glory of God. They all move, like loving sisters, hand in hand through the great universe. As they live with each other, so they evidently live for each other. Superstition, ignorance, and even wilful exaggeration have much obscured the effects of this mutual influence. The moon especially has been treated as if she existed for the benefit of the earth only. From the times of antiquity the world has been filled with fanciful stories of her influence on our weather, our vegetation, our health, and even the state of our mind. Many have believed in a daily direct communication between the two great bodies; they looked upon meteoric stones as coming to us directly from the craters of the moon's volcanoes, and the fertile imagination of happy dreamers reduced a crude mass of half-true, half-fabulous details into a regular system, long before the moon itself was even but tolerably well known to us. It is notorious that men of such rank as Piazzi and Sir William Herschel considered certain light appearances in the moon as volcanic eruptions, whilst a German astronomer of great merit, Schroeter, saw in them enormous fires raging in some of the capitals of our satellite! Meteoric stones are, in our day, fortunately better explained. Unless the volcanoes on

the moon had a force thirty times greater than our own, they could not project masses far enough to come within reach of our atmosphere. Such gigantic and continued eruptions could, moreover, not fail to cause some permanent change in the surface of the moon, of which no trace has as yet been perceived.

Great heavenly bodies commune not, like men, by throwing bombshells at each other; their influence is felt through the ageney of light, heat and attraction. The light of the moon, it is true, is ninety thousand times weaker than sunlight, and that its rays warm not, is a popular assertion. But people are not always right, with due deference be it said, even in matters of science. They used to say that moonlight nights were colder than others. So they are; but the moon is not to be blamed for it. She shines brighter when the sky is not obscured; but when that is the case, the earth also grows colder, because radiation is increased. Thus the two facts are perfectly true, only there is no connection of cause and effect between them. Melloni's experiments, made in 1846, prove even that the rays of the moon have a certain amount of heat, though so little, that the most powerful lenses fail to make it perceptible on the thermometer.

The old Phœnicians already knew the moon well as their faithful companion and guide on their long, bold sea voyages; they knew that the gigantic breathing of the ocean, its ebb and tide, were her work. Antiquity looked with awe and wonder upon this supernatural power of the great pale orb. Modern science sees in

it one of the most glorious effects of that great and mysterious power of attraction, which binds and holds the universe together. The moon, though so near to us, cannot move the firm continent, but she allures the elastic waters of the earth, until they raise huge foam-covered masses up towards the distant charmer. In one great, unbroken wave of vast dimensions they follow the receding moon with eager haste, and in the short space of twenty-four hours rush round our globe, until continent and island break their imposing power. Twice in the day and twice at night does this immense giant-snake, wound round our globe, breathe; for six hours it swells and rises high into the pure air of the atmosphere; for six hours afterwards it sinks and vanishes, falling back into its eternal limits. Although the mysterious sympathies of the great worlds of the universe are all alike, and sun and moon work jointly in this great movement, the power of the latter far exceeds, in this respect, by its greater vicinity to the earth, that of the sun. Hence the tides follow closely the magic course of the moon in the heavens, and recur regularly once in every twelve hours, twenty-five minutes, as far as they are not retarded by the resistance of the water itself, by coasts and winds, or by opposing currents. When sun and moon happen both to attract at the same time, the effect is, of course, incredibly heightened; so-called spring-tides rise at the period of full or new moon, rush with irresistible power high over cliffs and chalky ramparts, their gigantic arms long stretched out towards the moon, and fall upon the peaceful plain and the fertile fields of

the terrified husbandman. Still, man can conquer even the great magician in the heavens. He knows the hour when the wild army is approaching, he flees from the rage of the threatening tide waves, or he builds gigantic walls, against which they dash hissing and roaring; they tremble for an instant, as if drawing a last, full breath, and then break their iron front into harmless clouds of spray and foam.

As all attraction is mutual, the earth also causes an enormous tide on the moon; its power is eighty-one times stronger than that which produces our tides. The moon, we have seen, turns constantly only one side towards us; it is, therefore, but natural to conclude that so immense a power must have produced vast changes in her surface. Some believe, on this account, that, to restore the balance, the sea and the atmosphere of the moon have fled to the opposite side. So much is certain, that, thanks to the loving attraction of our mother earth, the side turned towards us rises at least a thousand feet above the regular form of a globe.

But the great ocean does not alone show the attraction of the moon in its tides; the huge mass of air, the atmosphere, that surrounds the earth, is likewise exposed to these forces. Ebb and tide on this vast, unmeasured ocean, are, of course, not perceptible far down in its depth, where we poor men breathe painfully; but only on the surface, to which even the boldest balloon sailor has never yet risen, and perhaps in the very delicate changes of susceptible barometers. The latter are, however, extremely minute; only from time to time some

great current in the atmosphere rushes down into the deep of the transparent ocean, and tells us in a roaring tornado, or the destructive violence of a fearful hurricane, of the mysterious movements in the airy waves, that were charmed by the magic power of the moon, and tried to leave their mother earth to hasten to the bewitching island in the blue, starry heavens.

But there is another strong, binding tie between moon and earth, that makes us thankful for the precious things put forth by the former. She has been the oldest and safest teacher, to whom mankind ever listened. Even the old Egyptians, Babylonians, Indians, and Greeks, whilst they worshipped her as a goddess, failed not carefully to observe the changes in her pale face and by them to measure their time. Like a faithful porter, she has ever stood at the gates of the great heavens with their countless stars, and taught us how to find times and distances. In the upper rooms of the eighth story of the lofty towers of Babylon, in the dark halls of the vast temples of Egypt, sat the hoary priests of antiquity, and watched the wanderings of the great star of the night, thus to order the times of the year and the labors of man. The moon has taught us the secrets of arithmetic and geometry; she was the first mathematician, she aided agriculture and navigation; she taught historians the order of great events, and gave to the priests of mankind their lofty positions by confiding to them the secret of her constant changes. Now, our astronomers make her the mirror on which the earth throws her image, when the sun is behind both, and thus prove on the moon's quiet surface, the round

form of our globe. The faint uncertain light, which at the time of the first quarter fills up the rest of the round orb, serves them to measure the intensity of the light which the earth diffuses. The perturbations in her motions teach them the respective powers of attraction of sun and earth, make known their form and reveal even the internal structure of the latter. Eclipses must serve as means to measure the height of lunar mountains, and to investigate more closely the secrets of the sun itself, and when the moon covers fixed stars, they learn by this the velocity of light, the distance of those stars and the density of our own atmosphere.

From a consideration of such signal services rendered to grateful mankind, we might well grant the moon a word now and then to the clerk of the weather. But the faith of our forefathers in this respect has been almost entirely destroyed. Neither the barometer itself, nor the most careful observations made during the space of twenty-eight years in the north, during fifty years in the tropics, show any reliable influence of the moon on our weather. Still the world adheres with a constancy, worthy of a better cause, to the ancient belief. The faithful prefer their own observations to those of abstract science, as they call it, and insist upon it that a change in the moon produces a change in the weather; what their grandparents taught them, they faithfully hand down to grandchildren. We all have a tendency to explain mysteries by new mysteries, and as no science has yet been able to enter into the great laboratory where rain and sunshine are manufactured, the world finds it easy and con-

venient to lay that duty upon the broad shoulders of the good old moon, and to make her, in a new sense, "a faithful witness in heaven."

But as among the chaff, many a plump good grain may be found, so the vast mass of superstitions about the influence of the moon on life on earth also contains, every now and then, a particle of truth. It is not denied that wood cut at the time of an increasing moon is more perishable than that cut at other periods, for repeated and careful observations made in the West Indies confirm the long-cherished opinion. Many farmers, also, firmly believe that all grain sown under an increasing moon prospers better on that account. That the light of the moon must have some little influence on vegetation, has been satisfactorily proved by the fact that plants, which had been bleached in darkness, recovered their green color by exposure to moonlight only.

The sick know the influence of the moon unfortunately but too well. Goitres are said to swell periodically with the full moon; liver-complaints to become worse at the same time, and the insane to suffer of more violent attacks of rage. Death itself, it is well known, frequently waits for the tide, that is, for the moon. It is much to be regretted that science, with haughty disregard, has thrown these popular notions aside without an attempt to sift them, a proceeding which cannot fail to deprive us of much that might otherwise become not only interesting, but even valuable. Since we have entered deeper into the secrets of life; since we know how incredibly delicate are the functions of our nerves; since we can

no longer deny the mysterious effects of magnetism, even though we may look upon them only as symptoms of disease and self-illusion; since we have to admit the efficacy of light, long after human eyes perceive it no longer —it is surely high time that we should try to find the grain of truth which is in every fable, and probably in these superstitions also. We are aware that men of science are sedulously employed in this noble undertaking, and that, for instance, in medicine very remarkable results have already been obtained.

This practical tendency need not destroy the sweet, magic charm, which the moon now, as of old, exercises over the soul of man. The poet tells us to-day, as he did yesterday, how the mountains kneel before God in silent prayer, when the peace of the sabbath reigns all around, how the host of stars light up the gigantic temple, and "the moon hangs, as the ever-burning lamp of man's worship, high above the eternal altar of nature." The painter studies the quaint, fairy lights of the pale orb, as it pours its mild radiance over field and town. The lover communes with the tender amber round which the moon spreads about her, moving through a fleecy night, and the pained heart finds sweet comfort in her peaceful silver light. The arctic traveller blesses her as she lights up with her faint but ever welcome favor, the long, cold polar night; and the people at large, look up to her for mysterious blessings. For many are the charms of the pale light of the moon, not known to the man of science. How peacefully and kindly she smiles through the window upon the little bed of the infant, and wakes

in its childish mind a thousand strange and fanciful notions, until gentle slumber closes those pure innocent eyes! Teasing and playing, she will come between that loving couple in the dark bower, and break in upon their sweet, silent communion. Beautiful as some fair saint, serenely moving on her way in hours of trial and distress, she watches like a mild, faithful companion by the side of the sick-bed; with peace and heavenly comfort in her sweet, pale face, she soothes the weary eye and shortens the long, painful night. Inspiration itself has asked, "Who is she that looketh forth as the morning, fair as the moon?" At last her gentle pilgrimage is ended; sinking silently she drops down behind the sky, a faithful witness of the brighter light that is to follow after this faint moonlight life, and a gladsome prophet of the abundance of peace which the Almighty has promised "as long as the moon endureth."

THE END.

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